

APPENDIX A

BUREAU OF ENVIRONMENTAL REMEDIATION

STANDARD OPERATING PROCEDURES

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APPENDIX A

STANDARD OPERATING PROCEDURE BER-01

COLLECTION OF GROUNDWATER SAMPLES AT KNOWN OR SUSPECTED GROUND WATER CONTAMINATION SITES

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1. INTRODUCTION

The objective of this Standard Operating Procedure (SOP) is to provide general reference information on sampling of ground water wells. This guideline is primarily concerned with the collection of water samples from the saturated zone of the subsurface. Every effort must be made to ensure that the sample is representative of the particular zone of water being sampled. These procedures are designed to be used in conjunction with analyses for the most common types of groundwater contaminants (e.g., volatile and semi-volatile organic compounds, pesticides, metals, biological parameters).

2. METHOD SUMMARY

Prior to sampling, the well must be purged. This may be done with a number of instruments. The most common of these are the bailer, submersible pump, non-gas contact bladder pump and inertia pump. At a minimum, three well volumes should be purged, if possible. Equipment must be decontaminated prior to use and between wells. Once purging is completed and the correct laboratory-cleaned sample containers have been prepared, sampling may proceed. Sampling may be conducted with any of several instruments, and need not be the same as the device used for purging. Care should be taken when choosing the sampling device as some will affect the integrity of the sample. Sampling equipment must also be decontaminated. Sampling should occur in a progression from the least to most contaminated well.

3. PROCEDURES

3.1 FIELD PREPARATION

- (1) Start at the least contaminated well, if known;
- (2) Lay plastic sheeting around the well to minimize the likelihood of contamination of equipment from soil adjacent to the well;
- (3) Remove locking well cap, note location, time of day, and date in field notebook or an appropriate log form;
- (4) Remove well casing cap;
- (5) When appropriate, screen the head-space of the well with an appropriate monitoring instrument to determine the presence of volatile organic compounds (VOCs) and record the instrument response in site logbook;
- (6) Lower water level measuring device or equivalent (i.e., permanently installed transducers or airline) into well until water surface is encountered;
- (7) Measure distance from water surface to reference measuring point on well casing or protective barrier post and record in site logbook. Alternatively, if there is no reference point, note that water level measurement is from top of steel casing, top of PVC riser pipe, from ground surface, or some other position on the well head.
- (8) Measure total depth of well (do this at least twice to confirm measurement) and record in site logbook or on log form;

- (9) Calculate the volume of water in the well and the volume to be purged using the calculations in Section 2.8; and
- (10) Select the appropriate purging and sampling equipment.

Floating Immiscible Product-- Prior to placing any water level measuring device or reusable bailer in a well, care should be exercised to ensure that free product is not present in the well. A disposable bailer may be lowered into the well to determine the approximate depth to water or depth to floating product. If floating product is observed, there is no need to collect a ground water sample unless specified by a site-specific project plan. An interface probe or a partially submerged, clear PVC bailer should be used to measure the floating product thickness and the depth to water in the well. An attempt should be made to describe the type, color, and viscosity of the product.

3.2 EVACUATION OF STATIC WATER (PURGING)

The volume of water purged from a well prior to sample collection depends on the intent of the monitoring program as well as the hydrogeologic conditions. Programs designed to evaluate overall quality of water resources may require long pumping periods to obtain a sample that is representative of a large volume of that aquifer. The pumped volume can be determined prior to sampling so that the sample is a composite of a known volume of the aquifer, or the well can be pumped until the stabilization of parameters such as temperature, electrical conductance, or pH has occurred.

However, monitoring for definition of a contaminant plume requires a representative sample of a small volume of the aquifer. These circumstances require that the well be pumped enough to remove the stagnant water but not enough to induce flow from other areas. Generally, three to five casing volumes are considered effective. Calculations can be made to determine the appropriate purge volume on the basis of well dimensions and aquifer parameters prior sampling (see Section 3.3). If the well can be pumped or bailed dry, the well should be purged until dry one time and allowed to recover before sampling (Reference 1).

Another approach that may be required by a sampling plan is to monitor one or more indicator parameters such as pH, temperature, or conductivity. The well is considered purged when the parameters stabilize over three or more consecutive measurements. An advantage to this method is that the volume of stored water present has no direct bearing on the volume of water that must be removed. A disadvantage to this approach is that there is no assurance in all situations that stabilized parameters represent formation water (Reference 2). Also, the instruments used to measure the parameters must be adequately maintained and operated.

The following well evacuation devices are most commonly used.

3.2.1 Bailers

Bailers are the simplest purging device and have many advantages. Bailers generally consist of a rigid length of tube, usually with a ball check-valve at the bottom. A line is used to lower the bailer into the well to retrieve a volume of water. The three most common types of bailer are PVC, Teflon, and stainless steel. This manual method of purging is best suited to shallow or narrow diameter wells. For deep, larger diameter wells which require evacuation of large volumes of water, other mechanical devices may be more appropriate.

- (1) Determine the volume of water to be purged as described in Section 3.4;
- (2) Lay plastic sheeting around the well to prevent contamination of the bailer line with foreign materials;
- (3) Attach the line to the bailer and lower until the bailer is completely submerged;
- (4) Pull bailer out ensuring that the line either falls onto a clean area of plastic sheeting or never touches the ground;
- (5) Empty the bailer into a 5-gallon bucket to measure the volume of water purged; and
- (6) Thereafter, pour the water into a container and dispose of purge waters as specified in the site- specific project plan.

3.2.2 Submersible Pumps

Submersible pumps are generally constructed of plastic, rubber, and metal parts which may affect the analysis of samples for certain trace organics and inorganics. As a consequence, submersible pumps may not be appropriate for investigations requiring analyses of samples for trace contaminants. However, they are still useful for pre-sample purging, but the pump must have a check valve to prevent water in the pump and the pipe from rushing back into the well.

Submersible pumps generally use one of two types of power supplies, either electric or compressed gas. Electric pumps can be powered by a 12-volt DC rechargeable battery, or a 110- or 220-volt AC power supply. Those units powered by compressed gas normally use a small electric compressor which also needs 12-volt DC or 110-volt AC power. They may also utilize compressed gas from bottles. Pumps differ according to the depth and diameter of the monitoring wells.

- (1) Determine the volume of water to be purged as described in 3.3;
- (2) Lay plastic sheeting around the well to prevent contamination of pumps, hoses or lines with foreign materials;
- (3) Assemble pump, hoses and safety cable, and lower the pump into the well. Make sure the pump is deep enough so that purging does not evacuate all the water (Running the pump without water may cause damage);
- (4) Attach a flow meter to the outlet hose to measure the volume of water purged. If a flow meter is not available, a 5-gallon bucket may be used to measure the volume

- of water purged;
- (5) Attach a power supply, and purge the well until the specified volume of water has been evacuated (or until field parameters, such as temperature, pH, conductivity, etc. have stabilized). Do not allow the pump to run dry. If the pumping rate exceeds the well recharge rate, lower the pump further into the well, and continue pumping; and
- (6) Collect and dispose of purge water as specified in the site-specific project plan.

3.2.3 Non-contact Gas Bladder Pumps

To provide the least amount of material interference with the sample, an all stainless-steel and Teflon Middleburg-squeeze bladder pump (e.g., IEA, TIMCO, Well Wizard, Geoguard, and others) is used for the purging procedure. Water comes into contact with the inside of the bladder (Teflon) and the disposable sample tubing. Some wells may have permanently installed bladder pumps (i.e., Well Wizard, Geoguard), that will be used to sample for all parameters.

- (1) Assemble Teflon tubing, pump and charged control box;
- (2) Use the same procedure for purging with a bladder pump as for a submersible pump; and
- (3) Be sure to adjust flow rate to prevent violent jolting of the hose as sample is drawn in.

3.2.4 Suction Pump

There are many different types of suction pumps, including centrifugal, peristaltic and diaphragm. Diaphragm pumps can be used for well evacuation at a fast pumping rate and sampling at a low pumping rate. The peristaltic pump is a low-volume pump that uses rollers to squeeze the flexible tubing, thereby creating suction. This tubing can be dedicated to a well to prevent cross-contamination.

- (1) Assemble the pump, tubing, and power source if necessary; and
- (2) Follow the procedures outlined for the submersible pump.

3.2.5 Inertia Pump

Inertia pumps (Trilock pump, WaTerra pump and piston pumps) are manually operated. They are appropriate to use when wells are too deep to bail by hand, but are not inaccessible enough to warrant an automatic (submersible, etc.) pump. These pumps are made of plastic and may be either decontaminated or discarded, after use.

- (1) Determine the volume of water to be purged as described in Section 2.2, Field Preparation;
- (2) Lay plastic sheeting around the well to prevent contamination of pumps or hoses

- with foreign materials;
- (3) Assemble pump, and lower to the appropriate depth in the well;
 - (4) Begin pumping manually, discharging water into a 5-gallon bucket (or other graduated vessel). Purge until specified volume of water has been evacuated (or until field parameters such as temperature, pH, conductivity, etc. have stabilized); and
 - (5) Collect and dispose of purge waters as specified in the site-specific project plan.

3.2.6 Domestic and Lawn and Garden Wells

- (1) Turn-on a household fixture (preferably an outside faucet) and allow well to discharge for 5 to 10 minutes. Be certain the discharge point is on the well-side of any water conditioning device or screen. Do not sample through garden hoses. Collect the sample directly from the faucet.

If specified by a site-specific project plan, monitor specified field parameters during the evacuation process. When field parameters are within 5 percent over three consecutive readings, the well is considered purged.

3.3 CALCULATIONS

The volume of one well casing of water can be calculated by multiplying the height of the water column (in feet) by the volume of water per linear foot (in gallons per foot). The volume of water in gallons per linear foot for several common sizes of monitoring wells are as follows:

<u>Well Diameter</u>	<u>Volume in gal/ft.</u>
2 inches	0.1632
3 inches	0.3672
4 inches	0.6528
6 inches	1.4688

EXAMPLE

One well volume for a 2" monitoring well with 12 feet of water would be calculated as follows:

$$12 \text{ feet } (0.1632 \text{ gallons/foot}) = 1.9 \text{ gallons}$$

Multiply 1.9 gallons by 3 or 5 to obtain the total volume of water to be purged.

The volume, in gallons per linear foot, for other monitoring well diameters can be calculated as follows:

$$v = nr^2 \text{ (cf)}$$

where:

v = volume in gallons per linear foot

n = pi

r = radius of monitoring well (feet)

cf = conversion factor (7.48 gal/ft³)

Remember to convert the well radius into feet before using this equation.

3.4 SAMPLING

Sample withdrawal methods require the use of pumps, bailers, and samplers. Ideally, purging and sample withdrawal equipment should be completely inert, economical to use, easily cleaned, sterilized, reusable, able to operate at remote sites in the absence of power resources, and capable of delivering variable rates for sample collection. It should be noted that, regardless of the sampling device (discussed below), all wells at a project should be sampled using the same type of sampling device in order to maintain consistency and to avoid introducing bias.

3.4.1 Bailers

The positive-displacement volatile sampling bailer is perhaps the most appropriate for collection of water samples for volatile analysis. Other bailer types (messenger, bottom fill, etc.) are less desirable, but may be mandated by cost and site conditions. Generally, bailers can provide an acceptable sample, providing that sampling personnel use extra care in the collection process.

- (1) Attach a line to the bailer. If a bailer was used for purging, the same bailer and line may be used for sampling;
- (2) Lower the bailer slowly and gently into the well, taking care not to shake the casing sides or to splash the bailer into the water. Stop lowering at a point adjacent to the screen;
- (3) Allow bailer to fill and then slowly and gently retrieve the bailer from the well, avoiding contact with the casing, so as not to knock flakes of rust or other foreign materials into the bailer;
- (4) Remove the cap from the pre-labeled sample container. Do not place the cap on the ground. *See Section 3.1 for special considerations on VOC samples;*
- (5) Begin pouring slowly from the bailer or open the stopcock;
- (6) Filter samples as required by sampling plan;
- (7) Cap the sample container tightly and place sample container in a cooler;
- (8) Log all samples in the site logbook and on field data sheets (if necessary);
- (9) Complete necessary paper work; and
- (10) Transport sample to decontamination zone to prepare it for transport to analytical laboratory.

3.4.2 Submersible Pump

Submersible pumps provide higher extraction rates than any other method, however some agitation in the well should be expected. The possibility of introducing trace metals into the sample from pump materials exists (Reference 2). Many submersible pumps are not appropriate for collecting samples once purging has been performed. VOCs may be removed by aeration by some pumps.

- (1) Allow the monitoring well to recharge after purging;
- (2) Reduce the flow of water to a manageable sampling rate;
- (3) Fill the appropriate bottles;
- (4) Cap the sample container tightly and place pre-labeled sample container in a cooler;
- (5) Log all samples in the site logbook and on the field data sheets (if required);
- (6) Complete necessary paperwork;
- (7) Transport sample to decontamination zone for preparation for transport to analytical laboratory; and
- (8) Upon completion, remove pump and assembly and fully decontaminate prior to moving to the next well to be sampled.

3.4.3 Non-Gas Contact Bladder Pumps

These pumps are also suitable for shallow (less than 100 feet) wells. They are somewhat difficult to clean, but may be used with dedicated sample tubing to avoid cleaning. These pumps require a power supply and a compressed gas supply (or compressor). They may be operated at variable flow and pressure rates making them ideal for both purging and sampling .

- (1) Allow well to recharge after purging;
- (2) Assemble the appropriate bottles;
- (3) Turn pump on, increase the cycle time and reduce the pressure to the minimum that will allow the sample to come to the surface;
- (4) Cap the sample container tightly and place pre- labeled sample container in a carrier;
- (5) Log all samples in the site logbook and on field data sheets and label all samples.
- (6) Package samples and complete necessary paperwork;
- (7) Transport sample to decontamination zone for preparation for transport to analytical laboratory; and
- (8) For filtered samples, connect the pump outlet tubing directly to the filter unit. The pump pressure should remain decreased so that the pressure build-up on the filter does not blow out the pump bladder or displace the filter. For the Geotech barrel filter, no actual connections are necessary so this is not a concern.

3.4.4 Suction Pumps

In view of the limitations of suction pumps, they are not recommended for sampling purposes.

3.4.5 Inertia Pumps

Inertia pumps may be used to collect samples. It is more common, however, to purge with these pumps and sample with a bailer.

- (1) Following well evacuation, allow the well to recharge.
- (2) Assemble the appropriate bottles.
- (3) Since these pumps are manually operated, the flow rate may be regulated by the sampler. The sample may be discharged from the pump outlet directly into the appropriate sample container.
- (4) Cap the sample container tightly and place pre-labeled sample container in a carrier.
- (5) Log all samples in the site logbook and on field data sheets and label all samples.
- (6) Package samples and complete necessary paperwork.
- (7) Transport sample to decontamination zone for preparation for transport to analytical laboratory.
- (8) Upon completion, remove pump and decontaminate or discard, as appropriate.

3.5 SPECIAL CONSIDERATIONS FOR VOC SAMPLING

The proper collection of a sample for volatile organics requires minimal disturbance of the sample to limit volatilization and therefore a loss of volatiles from the sample. Sample retrieval systems suitable for the valid collection of volatile organic samples are: positive displacement bladder pumps, gear driven submersible pumps, syringe samplers and bailers. Field conditions and other constraints will limit the choice of appropriate systems. The focus of concern must be to provide a valid sample for analysis, one which has been subjected to the least amount of turbulence possible. The following procedures should be followed:

- (1) Open the vial and collect the sample during the middle of the cycle. When collecting duplicates, collect both samples at the same time.
- (2) Fill the vial to just overflowing. Do not rinse the vial, nor excessively overfill it. There should be a convex meniscus on the top of the vial.
- (3) Check that the cap has not been contaminated (splashed) and carefully cap the vial. Place the cap directly over the top and screw down firmly. Do not overtighten and break the cap.
- (4) Invert the vial and tap gently. Observe the vial for a few seconds. If an air bubble appears, discard the sample and begin again. It is imperative that no air bubbles are present in the sample vial.
- (5) Immediately place the vial in the protective sleeve (if available) and place into the cooler, oriented so that it is lying on its side, not straight up.
- (6) The holding time for unpreserved VOAs is 7 days. Samples should be shipped or delivered to the laboratory daily so as not to exceed the holding time. Ensure that the samples remain at 4°C, but do not allow them to freeze.

3.6 FILTERING

For samples that require filtering, such as samples which will be analyzed for total metals, the filter must be decontaminated prior to use and between uses. Filters work by two methods. A barrel filter such as the "Geotech" filter works with a pump, which is used to build up positive pressure in a chamber containing the sample. The sample is then forced through filter paper (minimum size $0.45\ \mu\text{m}$) into a sample container placed underneath. The barrel itself is filled manually from the bailer or directly via the hose of the sampling pump.

A vacuum type filter involves two chambers, an upper chamber that contains the sample, and a filter (minimum size $0.45\ \mu\text{m}$) divides the chambers. Using a hand pump or a Gilian-type pump, air is withdrawn from the lower chamber, creating a vacuum and thus causing the sample to move through the filter into the lower chamber where it is drained into a sample jar. Repeated pumping may be required to drain all the sample into the lower chamber. If preservation of the sample is necessary, this should be done after filtering.

3.7 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Complete preservation of samples is practically impossible. At best, preservation techniques only retard the chemical and biological changes which occur after a sample is removed from the source. Therefore, insuring a timely analysis of a sample should be one of the foremost considerations in the sampling plan schedule. For ground water samples, immediate refrigeration to 4°C is often the best preservation technique available, but it is not the only measure nor is it applicable in all cases. Table 1 summarizes typical container and preservation requirements for ground water samples. The requirements for sample volumes and number of containers vary from laboratory to laboratory. A site specific project plan will determine the appropriate sample containers and preservatives. Samples should be collected directly from the sampling device into the appropriate laboratory-cleaned containers unless filtering is required. Complete a field data sheet (if required), a chain of custody form, and record all pertinent data in the site logbook.

Chain-of-Custody Records must be used to record the custody and transfer of samples. These forms must be entirely completed (N/A if not applicable). If directed by the site specific sampling plan, tamper-proof seals will be placed on either sample containers or shipping coolers. The seal number must be recorded on the Chain-of-Custody Form.

4. POST OPERATION

After all samples are collected and preserved, the sampling equipment should be decontaminated prior to sampling another well. This will prevent cross-contamination of equipment and monitoring wells between locations.

- (1) Decontaminate all equipment according to Standard Operating Procedure BER-05;
- (2) Replace sampling equipment in storage containers; and

- (3) Prepare and transport water samples to the laboratory. Check sample documentation and make sure samples are properly packed for shipment to a laboratory.

5. QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

- All data must be documented on field data sheets or within site logbooks.
- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

6. HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA and specific health and safety procedures. More specifically, depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. The site health and safety plan should be reviewed with specific emphasis placed on the protection program planned for the well sampling tasks. Standard safe operating practices should be followed such as minimizing contact with potential contaminants in both the vapor phase and liquid matrix through the use of respirators and disposable clothing.

For volatile organic contaminants:

- Avoid breathing constituents venting from the well;
- When appropriate, survey the well head-space with an FID/PID prior to sampling; and
- If monitoring results indicate organic constituents, sampling activities may be conducted in Level C protection. At a minimum, skin protection will be afforded by disposable protective clothing.

Physical hazards associated with well sampling are:

- Lifting injuries associated with pump and bailer retrieval, and moving equipment;
- Use of pocket knives for cutting discharge hose;
- Heat/cold stress as a result of exposure to extreme temperatures (may be heightened by protective clothing);
- Slip, trip, fall conditions as a result of pump discharge; and
- Restricted mobility due to the wearing of protective clothing.

7. REFERENCES

1. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response, *Compendium of ERT Ground Water Sampling Procedures*, EPA designation EPA/540/P-91/007, January 1991.
2. American Society for Testing and Materials, 1992, *Standard Guide for Sampling Ground Water Monitoring Wells*, ASTM Designation D4448-85a.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-02

COLLECTION OF SURFACE WATER SAMPLES AT SUSPECTED OR KNOWN CONTAMINATED SITES

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1. INTRODUCTION

Surface water samples may be required to establish the existence or extent of contaminant migration. Such data helps investigators identify risks to populations and determine appropriate remedial actions. Comparisons of water chemistry from sampling points upstream to sampling points on-site and downstream from the site are used to evaluate contamination releases.

2. EQUIPMENT

The equipment needed for surface water sampling during investigations of contaminated sites is minimal. In most instances, the sample container serves as the sampling device. The use of highly sophisticated or automatic sampling devices is normally not required for routine site investigations.

Several types of sampling devices are available for collecting surface water samples. The Nansen bottle, DO dunker, Kemmerer sampler and Van Dorn sampler are different types of samplers. The selection depends upon the method of sampling and the intended analyses. The following is a list of equipment used for surface water sampling:

1. Buffer Solutions (pH 4, pH 7 and pH 10)
2. Chain-of-Custody Seals
3. Container Brush
4. Conductivity Meter and calibration solutions
5. Containers (with screw caps lined with Teflon)
6. Dissolved Oxygen Indicator (w/probe for field use)
7. Distilled Water
8. Electrical Tape
9. Grease Pencils
10. Hip Boots
11. pH Meter and pH Hydrion paper - wide range
12. Plastic Beaker (1000 ml)
13. Polyethylene Bags (8" x 12", 10" x 16", and 12" x 20").
14. Pressure Filtering Apparatus
15. 0.45 micron filters and prefilter
16. Safety goggles
17. Sample Collection Device (Nansen bottle, DO dunker, Kemmerer Sampler and/or Van Dorn Samplers may be used)
18. Safety goggles

3. APPROACH

3.1 Selection of Sampling Locations for Field Sampling Plans

Surface water sampling locations are selected on the basis of their probability for demonstrating contaminant migration. Prior to sampling, the surface water drainage in and around a site should be

characterized using all available background information, including topographic maps and river basin studies. Air photos may be used to develop drainage maps which can then be confirmed by an initial survey of the surface water adjacent to or on a site. An initial survey of potential sampling points is essential to the development of a work plan. Further, it is possible to anticipate any special equipment or personnel safety requirements which might be necessitated by terrain or other factors. The initial survey also allows field personnel to identify landmarks which locate sampling points, a crucial step in maintaining documentation of activities for legal actions.

In general, sampling locations may include rivers, creeks, or streams running through or adjacent to a site, including those bodies of water which may receive surface runoff or leachate from a site. Surface water samples may also be collected from lakes, stock watering ponds, or other types of impoundments.

The number of sampling locations is dependent on a variety of factors, including the size of a site and the availability of analytical support. An absolute minimum number would be two locations, one background and one down-stream sample. Additional locations could be sampled to show concentration changes down-gradient from the source.

It is essential to establish the quality of water prior to its contact with the site. Surface drainage patterns should be carefully studied to determine background sampling locations. A minimum of one upstream sample is required for streams, although a background sample should be collected from each upstream surface water source entering the site. For standing bodies of water, a background sample may be collected from a similar water body away from the suspected area of contaminant release.

Ease of access to the sampling location maybe an important consideration when the samplers must carry a large amount of equipment to the site. Bridges sometimes provide good vantage points for sampling when composite samples are being collected. However, the need to sample point sources, such as stream flow from waste dumps, leachate breakouts, or drainage from mined areas may override site selection based on accessibility. Wading for water samples is not recommended in shallow lakes, ponds, and slow-moving rivers and streams because bottom deposits are easily disturbed resulting in increased sediment in the overlying water column. In slow moving, deep water, a boat is usually required for sampling.

3.2 Rivers, Stream, and Creeks

In the selection of surface water sampling sites on rivers, streams, and creeks, areas that exhibit the greatest degree of cross-sectional homogeneity should be located. When available, previously collected data may indicate if potential sampling locations are well mixed or vertically or horizontally stratified. Since mixing is principally governed by turbulence and water velocity, the selection of a site immediately below riffle areas provides good vertical mixing. Horizontal (cross-channel) mixing occurs in constrictions in the channel. When several stations along a stream are to

be sampled, they should be strategically located. Selection of sampling sites is often based upon accessibility, stream velocity, location of confluences, intake points for water supplies, and stream geomorphology.

Actual sample locations will vary with the size of the water body and the amount of turbulence in the stream or river. Generally, with small streams less than about 20 feet wide, a sampling site can be found where the water is well-mixed. In such cases, a single grab sample collected at mid-depth in the center of the channel is adequate to represent the entire cross-section. (A sediment sample can also be collected in the center of the channel.) For slightly larger streams, at least one vertical composite should be collected from mid-stream just below the surface, at mid-depth, and just above the bottom. Measurements of pH, temperature and conductivity are made and recorded on each aliquot of the vertical composite. Dissolved oxygen is an optional parameter. Several vertical composites should be collected in rivers. These vertical composites should be located in a manner that is roughly proportional to flow, i.e., they should be closer together toward mid-channel, where most of the flow travels, as opposed to toward the banks, where the proportion of total flow is smaller. The number of vertical composites required and the number of depths sampled for each are determined by the site Field Sampling Plan (FSP). The sample locations and numbers specified in the FSP should be based on a reasonable balance between two considerations:

- (1) The larger the number of subsamples, the more nearly the composite sample will represent the water body.
- (2) Taking many subsamples is time-consuming and expensive, and increases the chance of contamination.

More detailed descriptions of statistical basis for selecting surface water sampling sites are found in Handbook for Sampling and Sample Preservation of Water and Wastewater (EPA, Sept. 1982).

3.3 Lakes, Ponds, and Impoundments

Sampling locations may include any adjacent standing bodies of water such as lakes, stock watering ponds, sediment or flood control ponds, marshes, or ox-bow lakes which might be receiving contaminants. The number of water sampling sites on a lake, pond, or impoundment will vary with the depth, size and shape of the basin. Procedures for collecting samples from impoundments on hazardous waste sites should be evaluated if high concentrations of contaminants are indicated.

Standing surface waters have a much greater tendency to stratify than rivers and streams. The relative lack of mixing requires that more subsamples be collected. In ponds and small impoundments, a single vertical composite at the deepest point may be sufficient. In naturally formed ponds, the deepest point is usually near the center; in impoundments, the deepest point is usually near the dam.

In lakes and larger impoundments, several vertical aliquots may be composited to form a single sample. These aliquots are often taken along a transect or grid. The number of vertical composites and the depths at which samples are collected are outlined in the FSP.

Lakes with irregular shapes and with several bays and coves that are protected from the wind may require additional separate composite samples to represent water quality adequately. Similarly, additional samples should be taken where discharges, tributaries, land use characteristics, and other such factors are suspected of influencing water quality.

3.4 Leachates

Leachates can be formed by the mixing of rain water with wastes. A leachate may enter ground water systems causing deterioration of the water quality. In areas where the ground surface slopes steeply away from the buried wastes, the leachate may "break out" or emerge on the ground surface. This situation is typically encountered at landfills or at the foot of mine tailings disposal piles. Samples taken from leachate streams may have to be treated as medium or high concentration samples depending upon the field evaluation.

4. TECHNIQUES

Most surface water samples taken during site investigations are grab samples. Typically, surface water sampling involves immersing the sample container in the body of water; however, the following suggestions will help ensure that the samples collected are representative of site conditions.

- (1) The most representative stream samples are collected from mid-channel at 0.6 stream depth in a well-mixed stream;
- (2) Stagnated areas or pools in a stream or river might contain zones of varying pollutant concentrations, depending upon the physical/chemical properties of the contaminants and the proximity of these stagnated areas to the site;
- (3) When sampling running water, it is suggested that sampling progress from downstream to upstream to eliminate sediment disturbance in subsequent samples. When samples are collected directly into sample bottles, there will be no concern for cross-contamination if high contaminated areas are sampled first;
- (4) To sample a pond or other standing body of water, the surface area may be divided into grids. A series of samples taken from each grid is combined into one sample, or several grids may be selected at random;

- (5) Care should be taken to avoid excessive agitation of the water during transfer from source to bottle. Agitation could result in the loss of volatile constituents;
- (6) When collecting samples in 40 ml septum vials for volatile organic analysis, exclude any air space from the top of the bottle and to be sure that the Teflon liner faces in after the bottle is filled and capped. The container should be slowly filled to overflowing. After sealing, the bottle should be turned upside down and shaken to check for air bubbles. If air bubbles are present, the bottle should be filled with more sample and resealed;
- (7) Do not sample at the water surface unless sampling specifically for a constituent which is immiscible and on top of the water. Instead, the sample container should be inverted, lowered to the approximate depth, and held at about a 45-degree angle with the mouth of the bottle facing downstream; and
- (8) When sampling a small stream, seep, spring, pool, etc., the water may be too shallow or inaccessible to utilize the sample bottle for direct collection of the sample. Instead, a stainless steel ladle may be dipped into the water and the water transferred into the sample bottle. Care should be taken to minimize agitation of the sample during transfer.

APPENDIX A

STANDARD OPERATING PROCEDURES BER-03

COLLECTION OF SOIL SAMPLES FOR LABORATORY ANALYSIS

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1. INTRODUCTION

The objective of this Standard Operating Procedure (SOP) is to establish guidelines for the collection of soil samples for laboratory analysis. This SOP is applicable to soil samples collected from hand auger samplers, slide-hammer samplers, grab samples from stockpiled soils, surface samples, test pit samples, etc. To collect soil samples from split-spoon samplers during drilling refer to SOP BER 06. To collect soil samples using a Geoprobe refer to SOP BER 07.

2. METHOD SUMMARY

Soil samples may be collected in either a random or biased manner. Random samples can be based on a grid system or statistical methodology. Biased samples can be collected in areas of visible impact, points required to meet regulatory compliance or suspected source areas. Soil samples can be collected at the surface, shallow subsurface, or at depth. When samples are collected at depth, the water content should be noted, since generally "soil sampling" is restricted to the unsaturated zone. Equipment selection will be determined by the depth of the sample to be collected, surrounding terrain, and accessibility. A thorough description of the sampling locations and proposed methods of sample collection should be included in the work plan.

Commonly, surface sampling refers to the collection of samples at a depth interval of 0 to 12 inches. Certain regulatory agencies may define the depth interval of a surface sample differently, and this must be defined in the work plan. Collection of surface soil samples is most efficiently accomplished with the use of a stainless steel trowel or scoop. For samples at greater depths, a bucket auger, power auger, or slide-hammer may be needed to advance the hole to the point of sample collection. To collect samples at depths, greater than what's practical using hand equipment, the use of a drill rig with a split spoon sampler or a Geoprobe with a soil sampler may be necessary. In some situations, sample locations are accessed with the use of a backhoe.

3. MATERIALS/EQUIPMENT

The following materials may be used:

- (1) A work plan which outlines soil sampling requirements.
- (2) Field notebook, field form(s), maps, chain-of-custody forms, and custody seals.
- (3) Decontamination supplies (including: non-phosphate, laboratory grade detergent, buckets, brushes, potable water, de-ionized or distilled water, regulatory-required reagents, etc.)
- (4) Sampling device (stainless steel hand auger, slide-hammer soil sampler, stainless steel trowel, etc.).

- (5) Stainless steel spoons or spatulas.
- (6) Disposable sampling gloves.
- (7) Laboratory-supplied sample containers with labels.
- (8). Cooler with blue or wet ice.
- (9) Plastic sheeting.
- (10) Black pen and indelible marker.
- (11) Zip-lock bags and packing material.
- (12) Tape measure.
- (13) Paper towels or clean rags.
- (14) Masking and packing tape.
- (15) Overnight (express) mail forms (if needed).

4. DECONTAMINATION

All reusable sampling equipment will be thoroughly cleaned according to KDHE's decontamination SOP, BER-05. Disposable items such as sampling gloves and plastic sheeting will be changed after each use and discarded in an appropriate manner.

5. PROCEDURE

- (1) Prior to collecting soil samples, ensure that all sampling equipment has been thoroughly cleaned according to the decontamination SOP BER-05.
- (2) Using disposable gloves and a pre-cleaned, stainless steel spatula or spoon for each sample, extract the soil sample from the sampler. Where allowed by regulatory agency(ies), disposable plastic spoons may be used.
- (3) Place the sample in a laboratory-supplied, pre-cleaned sample container. Collection of soil samples for volatile organic compounds (VOC) analysis should be made directly into a sample jar or a sample liner placed in the sampler to be submitted directly to the laboratory. Lids of sample jars must have a Teflon liner. When using sample liners, Teflon film should be placed between the sample and the cap.

- (4) The sample container will be labeled with appropriate information such as, client name, site location, sample identification (location, depth, etc.), date and time of collection, and sampler's initials.
- (5) If soil samples are to be composited, the samples can be composited either in the field or the laboratory. To composite soil samples in the field, equal portions of the sample, either by volume or weight, must be collected from selected sampling locations. The discrete sample portions must be placed either on a plastic sheet or in an appropriate container, such as an aluminum or stainless steel pan, in order to homogenize the sample. If placed on a plastic sheet, the sample will be homogenized by quartering the sample by the repeated diagonal folding of the corners. If placed in a container, the sample will be homogenized by mixing with an appropriate tool such as a stainless steel spoon. Mixing is often not complete with heavy or wet soils. Soils may have to be dried and pulverized prior to compositing. Alternately to compositing in the field, several discrete samples may be submitted to the laboratory for compositing. The method used may be dependent upon regulatory requirements. Specific compositing procedures shall be approved by the appropriate regulatory agency and described in the work plan. **Samples to be analyzed for VOCs will not be composited unless required by a regulatory agency.**
- (6) After the sample has been collected and put into a container, labeled, and logged in detail, it is placed in a zip-lock bag and stored in a cooler at 4°C.
- (7) A chain-of-custody form is completed for all samples collected.
- (8) Soil samples should be delivered to the laboratory as soon as practicable. Check the work plan to determine if any analytes require a particular delivery or holding time.
- (9) If field-based analysis or field screening are being made on the soil samples, follow the appropriate SOP: Mobile Laboratory-BER 07; x-ray fluorescence metal analysis-BER 27; screening for VOC vapors using a PID or colorimetric tubes-BER 13.
- (10) The field notebook and appropriate forms should include, but not be limited to the following: site location, sample location, sample depth, sample identification, date and time collected, sampler's name, method of sample collection, number and type of containers, geologic description of material, description of decontamination procedures, etc. A site map should be prepared with exact measurements to each sample location in case follow-up sampling is necessary.
- (11) All reusable sampling equipment must be thoroughly cleaned in accordance with the decontamination SOP. Discard any disposable material or waste generated at the site in an appropriate manner that is consistent with site conditions.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-04

COLLECTION OF SEDIMENT SAMPLES

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1. INTRODUCTION

For the purposes of this procedure, sediments are those mineral and organic materials situated beneath an aqueous layer. The aqueous layer may be either static, as in lakes, ponds, or other impoundments or flowing, as in rivers and streams.

Sediment samples are valuable for locating pollutants of low water solubility and high soil binding affinity. Where surface water might show trace quantities of contaminants, thus leading investigators to believe that off-site contaminant migration is minor, the analysis of sediments might show otherwise. Heavy metals and high molecular weight hydrocarbons are examples of contaminants which might be found in greater concentrations in sediments than in the stream water.

Substrate particle size and organic content are directly related to water velocity and flow characteristics of a body of water. Contaminants are more likely to be concentrated in sediments typified by fine particle size and a high organic content. This type of sediment is most likely to be collected from depositional zones. In contrast, coarse sediments with low organic content do not typically concentrate pollutants and are found in erosional zones. The selection of a sampling location can, therefore, greatly influence the analytical results.

It is important to note that the sediments obtained from surface impoundments, such as lagoons, which are suspected to be highly concentrated are to be handled and treated as hazardous (concentrated) materials samples. This section addresses collecting those samples that can be treated and handled as environmental samples.

2. EQUIPMENT

- Aluminum pie pans
- Aluminum Foil
- Bucket Auger with butterfly valve (extension handle)
- Camera 35mm and film
- Chain-of-Custody Seals
- Coolers
- Dredge (Ekman or Ponar)
- Glass Jars (8 oz. wide mouth w/Teflon lined caps)
- Labels
- Measuring Tape
- Mobile Soil Drill

Plastic Sheets/Tarps
Pliers (10" forged slip joint, 8" lineman's, 8" long nose, and 8" slip joint)
Pocket Knife
Posthole Digger
Rope (Nylon)
Safety Equipment
Scoop
Shovel
Spatula
Split Spoon Sampler
Survey Flags of Buoys + Anchors
Tool Box
Vials
Wooden Spoons

3. APPROACH

The review of background information gives an indication of the types of substances which may be present in sediments. The following items should be considered when sampling.

- (1) Many pollutants adsorb onto sediments having a large surface-to volume ratio. Therefore, silts and clays will contain higher concentrations of organic compounds and trace metals than coarser sediments such as sands and gravels.
- (2) Hydrogeologic information should be recorded which can help establish a relationship between the contaminant source and the contaminants in sediments.
- (3) Samples for organic analyses should not be collected from areas exposed to the air during periods of low flow or low recharge.
- (4) The pH of the surface water over the sediments should be determined to identify any unusual pH conditions which would influence contaminant mobility and retention by the sediments.
- (5) Sediment samples should be obtained from the area nearest the suspected contaminant point source.

- (6) Background sample(s) should be obtained from sediments upstream from the suspected point source for running water, and from sediments away from the suspected point source for standing surface water. In cases of high contamination of small bodies of standing water, it may be impossible to find a background sample. The analysis of background sediments is required to establish the contribution of the source to contaminant levels in the area.
- (7) Chemical preservation of solids is generally not recommended. Cooling is usually the best approach, supplemented by the appropriate holding time.

4. TECHNIQUES

Very simple techniques can usually be employed for sediment sampling. Selection of a sampling device is most often contingent upon: 1) the depth of water at the sampling location, and 2) the physical characteristics of the medium to be sampled. Most samples will be grab samples, although sometimes sediment taken from multiple locations may be combined into one sample to reduce the amount of analytical support required. Composited samples are not acceptable for VOC analysis. Suggested techniques include the following:

- (1) In small, low-flowing streams or near the shore of a pond or lake, a sample container (8-ounce wide-mouth jar) may be used to scrape up the sediments. Collect 4 to 8 ounces of material.
- (2) To obtain sediments from larger streams or farther from the shore of a pond or lake, a Teflon beaker attached to a telescoping aluminum pole by means of a clamp may be used to dredge sediments. In most circumstances, a number of sediment samples should be collected along a cross-section of a river or stream to characterize the bed material. A common procedure is to sample at quarter points along the cross-section of the site selected. When the sampling technique or equipment requires that the samples be extruded or transferred at the site, they can be combined into a single composite sample. However, samples of dissimilar composition should not be combined, but should be stored for separate analysis in the laboratory.
- (3) To obtain sediments from rivers or in deeper lakes and ponds, a spring-loaded sediment dredge or benthic sampler may be used by lowering the sampler to the appropriate depth with a rope. The sediments thus obtained are placed into the sample container. When collecting sediment samples in lakes, ponds, and reservoirs, the site selected should be approximately at the center of water mass. This is particularly true for reservoirs that are formed by the impoundment of rivers or

streams. Generally, the coarser grained sediments are deposited near the headwaters of the reservoir, and the bed sediments near the center of the water mass will be composed of fine-grained materials. The shape, inflow pattern, bathymetry, and circulation must all be considered when selecting sediment sampling sites in lakes and reservoirs. In rivers or streams, fine grained sediments are deposited on the inside of bends and downstream from islands and other obstructions.

- (4) The sampling device should be decontaminated between locations according to KDHE SOP BER-05.
- (5) When sampling sediment from bodies of water containing known or suspected hazardous substances, adequate precautions must be taken to ensure the sampler's safety. The team member collecting the sample should not get too close to the edge of the water, where bank failure may cause him or her to lose their balance. To prevent this, the person performing the sampling should be on a lifeline, and be wearing adequate protective equipment. If sampling from a vessel is necessary, implement appropriate protective measures.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-05

DECONTAMINATION OF EQUIPMENT

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1. INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to establish a consistent process for decontamination of sampling equipment to prevent cross-contamination between sampling locations and events. Preventing cross-contamination in samples is important for reducing the introduction of error into sampling results, and for protecting the health and safety of site personnel.

2. METHOD SUMMARY

Gross contamination of equipment requires physical removal by methods such as brushes and high pressure water. This is followed by washing and rinsing the equipment.

3. PROCEDURE

- (1) When applicable, gross contamination should be removed with a metal or nylon brush and/or high pressure water spray.
- (2) Wash equipment with a non-phosphate detergent solution such as alconox or an equivalent.
- (3) Rinse with tap water.
- (4) Final rinse with deionized water.

4. GENERAL CONSIDERATIONS

- (1) The use of distilled or deionized water commonly available from commercial vendors is acceptable for decontamination of sampling equipment, provided that it has been verified by laboratory analysis to be analyte free.
- (2) Several procedures can be established to minimize contact with waste and the potential for contamination. For example:
 - Stress work practices that minimize contact with hazardous substances.
 - Use appropriate personal protective equipment (e.g. gloves) when handling contaminated equipment.
 - Use disposable sampling equipment when appropriate.
- (3) Sampling equipment that requires the use of plastic tubing should be disassembled and the tubing replaced with clean tubing between sampling locations.

- (4) As part of the work plan or health and safety plan, develop a decontamination plan before any personnel or equipment enter areas of potential exposure. The equipment decontamination plan may include:
- the number, location and layout of decontamination stations;
 - which decontamination apparatus is required;
 - methods for disposal of contaminated clothing, disposable equipment and water.

5. SPECIAL CONSIDERATIONS

Sample containers used by KDHE/BER personnel will be decontaminated by the laboratory or vendor from which the containers are obtained. The exception are brass liners used for Geoprobe closed-piston soil samplers and AMS core soil samplers. Contaminated brass liners will first be decontaminated as described in Section 3, then will be heated at 105° C for a minimum of one hour. New liners received from a vendor will be considered analyte-free.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-06

INSTALLATION OF MONITORING WELLS

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1. INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to establish a basic procedure for installation of auger-advanced monitoring wells. Use of this SOP is limited to KDHE and KDHE contractors. Monitoring wells installed as part of groundwater investigations are intended to serve several purposes:

- A. to indicate the presence, if any, of contaminants of interest in groundwater;
- B. to quantify the concentrations, sources, and vertical distributions of contaminants;
- C. to serve as a means of obtaining basic hydrogeologic information including static water level of the aquifer of concern, type and thickness of subsurface materials, aquifer characteristics at various depths, depth of the bedrock, etc.

2. METHOD SUMMARY

For wells to be installed with augers, a minimum hollow-stem auger size of 3 3/4" inside diameter or larger) should be used to advance monitoring wells. Placement, depth and construction of wells should be conducted under the supervision and direction of a KDHE geologist. Care should be taken to not introduce contamination from the drill rig or surficial area around the well head.

3. PROCEDURE

Monitoring wells are generally constructed of polyvinyl chloride (PVC) casing and screen that are placed at intervals determined by the project geologist. Typical sizes for the casing are nominal inside diameters of 2 inches, 4 inches, 5 inches, or 6 inches. Deeper wells may require a larger diameter casing or multiple casing strings of progressively smaller diameter casing (4 or 6 inch surface casing with 2 inch inside casing) to exclude shallower zones from the desired screen interval. The PVC pipe and screen is required to be of a minimum thickness depending on the depth of the well. For wells less than 200 feet deep, a minimum of Schedule 40 PVC casing and screen should be utilized. Wells over 200 feet should utilize Schedule 80 or heavier casing. Clean pipe and screen must be used in all wells. The screen at the bottom of the well should be sealed with a bottom plug of PVC. Well development criteria, methods and desired volume are site-specific and should be determined by the KDHE Project Manager on a site-specific basis.

Well screen should be constructed of PVC pipe with factory cut slots. The slot size is typically 0.010 inch, although other slot sizes may be used if appropriate for the formation and approved by the supervising geologist. Screen will be installed at the intervals directed by the supervising geologist, based on the requirements of the project and the site conditions. The casing must not be cleaned or cemented with organic solvents or solvent based cements. Suitable fastening methods for those

applications are either flush-joint threaded pipe, or slip-joint pipe fastened with stainless steel screws. When a monitoring well is to be used for detection of heavy metals, care must be taken in the choice of tools and supplies to avoid introducing soluble metals into the well.

A gravel pack is used to fill the annulus between the inside of the borehole and the outside of the casing. A minimum of four (4) inches of annulus plus the well casing (6 inches in diameter minimum for a 2 inch casing) is required. The gravel should be of clean silica sand, having a particle size appropriate for the formations in which it is to be used, and the slot size of the screen. The gravel pack material must be selected or approved by the geologist supervising the drilling. The gravel pack should be installed to two feet above the screened interval to avoid potential grout penetration into the screen. Centralizers may be required to obtain accurate placement of the gravel pack material. Disinfection of the sand or gravel is not required.

A grout plug consisting of at least 24 inches of bentonite chips, pellets or similar impervious material must be placed above each aquifer. In addition, the top 20 feet of the well must be grouted with bentonite, neat cement, or concrete, and the well head must be protected with an apron and locking well cover as described below. Bentonite is preferred as an annular seal and grouting agent. In some cases it will be necessary to install wells which have less than 20 feet of grout. If less than 20 feet of grout is determined for a well, a waiver must be obtained from BOW.

The casing shall extend at least one foot, but not more than three feet above the ground surface, and have a removable PVC cap, unless a flush mount protective cover has been approved by the project manager and a waiver granted by BOW. The well head shall be surrounded by a concrete apron, at least four inches thick and two to three feet square, centered around the well head above normal ground level, and sloped to drain away from the well. A locking well cover, constructed of welded steel, and having a suitable hasp will be installed at each well to prevent unauthorized access to the well. The well cover shall be firmly set in the concrete apron. Flush mount well protectors may be substituted for those described above if approved by the project manager.

4. GENERAL CONSIDERATIONS

- Well construction details and geologic logs should be recorded by the on-site geologist during the well installation. The appropriate BOW WWC-5 water well construction documentation must be completed within 30 days of well completion.
- Prior to drilling, development, sampling or other activities in connection with construction or use of a monitoring well, all equipment and tools must be cleaned in a suitable fashion. For most circumstances, the procedures outlined in BER-05 should be used.
- Only Schedule 40 or 80 casing and screen will be permitted for small-diameter monitoring wells. Only threaded casing will be used, with no glues, solvents, joint compounds or adhesives.

- Precautions must be taken during all stages of the drilling, installation, and development activities to prevent possible contamination of the well. Grease, fuel, hydraulic fluids, and other foreign materials from the drilling rig and equipment must be isolated from the well. Tools, casing, and drilling fluids must be kept clean and oil free. Clean tap water may be used in situations where heaving conditions are anticipated, however the water source should be sampled for the parameters and constituents of interest to account for water quality of tap water source.
- The well head apron and locking well cover is intended to prevent accidental or intentional introduction of foreign materials into the well. The well cap and locking cover should be installed as soon as practical, and must be locked to prevent tampering with the well. Drainage on the surface in the area of the well should be planned or modified so that there is no standing water in the area of the well, and so that the well will not be subject to runoff or infiltration from known sources of contamination.
- Disposal of cuttings and development/purge water should be performed according to the appropriate KDHE SOP (BER-08).

5. SPECIAL CONSIDERATIONS

The driller must be trained to operate the specific rig in use. For non-KDHE drillers, all drillers must be licensed through KDHE's Bureau of Water to install wells. Safety is a primary concern, and overhead utilities should be checked by the driller to assure that a minimum clearance of 20 feet (vertically and horizontally) exists between the mast in the upright position and any overhead power lines. All well placement, logging, and drilling operations must be under the supervision of a KDHE or Kansas Licensed Professional Geologist. The KDHE Project Geologist may desire to conduct in-field analysis of cuttings or development water during drilling, and the appropriate KDHE SOP should be consulted for the field analytical procedures to be utilized.

APPENDIX A

STANDARD OPERATING PROCEDURES BER-07

KDHE GEOPROBE OPERATIONS

BUREAU OF ENVIRONMENTAL REMEDIATION

STANDARD OPERATING PROCEDURE BER-07

KDHE GEOPROBE OPERATIONS

Revisor: Farrell Dallen Date of Revision: July 3, 2000

Remedial Section Chief: _____ Date: _____

Tank Section Chief: _____ Date: _____

ARS Section Chief: _____ Date: _____

Bureau Manager: _____ Date: _____

Revisor: Farrell Dallen Date of Revision: November 15, 2005

Remedial Section Chief: _____ Date: _____

Tank Section Chief: _____ Date: _____

ARS Section Chief: _____ Date: _____

Bureau Manager: _____ Date: _____

Revisor: _____ Date of Revision: _____

Remedial Section Chief: _____ Date: _____

Tank Section Chief: _____ Date: _____

ARS Section Chief: _____ Date: _____

Bureau Manager: _____ Date: _____

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1. INTRODUCTION

This document describes minimum operating requirements and recommended techniques for use of the 5400 Geoprobe and the 4200 Geoprobe units. Procedures which are mandatory, due to safety considerations or to minimum requirements for accuracy, are described in terms of **will** or **must**, while recommendations for good operating technique, efficiency, or enhanced accuracy, are worded as activities that the operators **should** or **may** perform.

The procedures assume that two assigned persons will perform all of the necessary activities to operate the equipment, and that they are familiar with the use of the mechanical and analytical equipment and with scientific investigations of contamination sites. These operating procedures are not intended to substitute for training or experience, but to outline the reasonable minimum requirements for performing routine investigations with the equipment. The operators are expected to use their informed and reasonable judgement to interpret and implement the procedures, and to develop means to solve unforeseen problems as they arise.

2. SAMPLING PROCEDURES

2.1. Probe Equipment Operation

2.1.1. Safety Considerations

The probe operator is the primary person to monitor for personnel safety in operating the vehicle and hydraulic probe system. Among the safety considerations are the following:

- A safe working area must be maintained when operating the sampling equipment in a street or public traffic area. Traffic cones should be used to close a lane if necessary, and good visibility for drivers and KDHE staff should be maintained around the work area.
- Hands and feet of operators and bystanders must be kept clear of moving parts, such as the probe foot and the drive head. Care must also be taken to prevent damage to the probe or the vehicle in extending and storing the probe. Unauthorized persons are not to be allowed to operate the hydraulic equipment.
- All work sites must be cleared for underground utilities and buried equipment before the probe is driven. 1-800-DIG-SAFE **must** be called to clear buried utilities. A Utilities Clearance Form must be completed and included in the project file.

- The Geoprobe units are much larger and heavier than most personal vehicles, and may handle awkwardly in some situations. Drivers should keep the size and limitations of the units in mind at all times to avoid accidents.
- Steel-toed boots must be worn when assisting or operating a Geoprobe Unit. Hearing protection must be used during hammering operations of the Geoprobe Unit.

2.1.2. Routine Equipment Maintenance

The probe operator should perform routine maintenance checks daily and weekly when operating the units. Daily checks should include:

- Check the hydraulic system for obvious leaks, and maintain the equipment in a clean and serviceable condition. In particular, oil and grease should not be allowed to accumulate where it can contact the probe rods, rod caps, or sampling tools and equipment.

Weekly maintenance checks should also address the following:

- Check the vehicle's motor oil and transmission fluid and refill if necessary.
- Check and refill the hydraulic fluid if necessary.
- Watch for damage to mechanical equipment (i.e. rods and hoses.) Hydraulic equipment and hoses must be inspected for cracks or damage to prevent mechanical failure, personnel injury, or down hole contamination.

2.2. Operating Procedures

Quality and integrity of the samples will be a principal concern of the operator, second only to personnel safety. Principal sources of error in sampling include contamination of tools or sampling equipment, air leaks caused by poorly fitting probe connections or leaky sample tubing, and improper sampling, such as trying to sample an impermeable or water saturated zone for soil gas.

2.2.1 Probe Operating Technique

It is good operator technique to turn off the hydraulic system switch to relieve pressure on the system and save fuel whenever the hydraulics are not in use. The operator should also turn off the vehicle engine whenever it is not in use to reduce exhaust fumes and noise in the working area. The drive hammer should be operated only when there is weight applied to the probe by the drive head. Use of the hammer without a load on the drive head causes undue wear and possible damage to the

hammer and probe equipment. The drive head must not be allowed to lift the foot of the probe off the ground more than 6" to 10". Lifting the foot off the ground too high will lift the rear wheels of the van from the ground, causing an unsafe condition that may allow the van to fall in any direction, possibly injuring personnel and damaging equipment. The units should be operated with the hydraulic system switch set at low speed when folding in and out of the vehicle and when advancing the initial probe rod.

2.2.2. Operator Log Book

The probe operator should maintain a field log book or maintain a file with the following information about each sample collected:

- The names of all field personnel
- The project name or location
- A sample identification number
- Date and time that the sample was taken
- The location and depth of the sample
- The type of sampling performed (soil gas, water, soil, vertical profile)
- Weather and site conditions, if they are relevant
- Other information, including drilling through pavement or rocks if necessary, tool or equipment breakage, stains and odors noted at the site, and problems encountered.

If the project manager is keeping a field log book that contains this information, the probe operator does not need to duplicate the effort.

2.3. Soil Gas Sampling

Soil gas is collected using the Post-run Tubing (PRT) system. Probe rod is advanced to the desired depth with a PRT point holder and an expendable point attached to the lead rod. The rod train is retracted 2 to 3 inches. A PRT point popper, attached to extension rods, is inserted into the rods to force the expendable point out of the point holder. A PRT adapter attached to tubing is inserted down the rod bore and connected to the point holder. Three tubing volumes are purged from the system using a 60 milliliter air-tight syringe with an attached three-way valve. If 1/4 inch ID tubing is used approximately 18 milliliters per foot of tubing are purged from the system prior to sampling. If 1/8 inch ID tubing is used approximately 4.5 milliliters per foot of tubing are purged from the system. After the soil gas sample is collected in the syringe that was used to purge the system, the sample is analyzed in a mobile laboratory following BER-25.

To collect laboratory soil gas samples, a 1 liter or smaller stainless steel canister is used. The canister is provided by the laboratory and has been cleaned and evacuated prior to sending to the field. After the sample has been collected for field-based analysis, the canister is attached to the soil

gas tubing. The control valve on the canister is opened allowing the evacuated canister to draw soil gas from the probe into the canister.

2.4. Ground Water Sampling

Water samples may be collected directly from the rod string by using either a slotted rod or the 15-point sampling system (drop out screen). A pre-probe may precede the slotted rod if the operator feels it is necessary. After the probe has been driven to the desired sampling depth, an electronic static water level indicator may be used to check for ground water in the probe rods. A polyethylene tube will be inserted inside the rods with a check valve attached. The tube can act as an inertia pump by physically moving the tube up and down inside the rods. All sample locations should be purged. Once the desired amount of water is purged from the probe, samples may be collected. Profile samples can be collected using a mill-slotted rod by collecting samples from the top of the water table down. If a 15-point sampling system is used a discrete hole must be used for each sample depth.

All water samples other than volatile organic chemical(VOC) samples may be collected by pumping directly into the sample container or into another container such as a cube container for heavy metal samples prior to filtering. To collect VOC samples, the tube is pinched off at the top to retain the sample in the tube. The tube is pulled out of the rod with care being taken to avoid the tube touching the ground or any source of contamination. The check valve is removed from the tube. One sampler holds the VOC vial at the bottom end of the tube. A second sampler holds the pinched end of the tube and controls the flow of the sample from the tube to the VOC vial by releasing pressure on the pinched area of the tube and adjusting the height of the tube to allow proper sample flow into the VOC vial. Samplers must wear sampling gloves while performing this operation.

The vacuum system may be used to purge the system and to collect samples instead of using the check valve system. With the vacuum system the samples may be drawn directly into the sample container or poured from a clean purge bottle. It is not recommended to use the vacuum system to collect VOC samples.

If the geology is such at the site that ground water is not easily obtained in the probe rods, a temporary well maybe set by removing the probe rods and inserting 0.5" schedule 80 PVC screen and casing.

All samples are to be properly preserved and stored until they reach the laboratory.

2.5. Soil sampling

KDHE has the capability to collect soil samples using three different methods with the geoprobe—the Large Bore Soil Sampler, the Macro-Core Sample, or the Dual Tube Method.

The Large Bore Soil Sampler is a closed piston sampler used for sampling at discrete depths. When collecting soil samples using the Large Bore Soil Sampler, which is a two-foot sampler, the sampler will be pushed in front of the push rods. The Large Bore Soil Sampler can be lined with either an acetate liner or a brass liner. The sampler is pushed to the top of the desired collection depth. The stop pin holding the piston in place is removed through the center of the rods. The sampler is advanced into the ground an additional two feet. The hammer is activated to start the pushing in order to open the piston so the sample will enter the sampler. After the rods have been pushed the additional two feet, the rods are pulled out of the ground. The liner is removed from the sampler and the sample is transferred to the appropriate sample containers. The brass liner is four six-inch sections held together with heat-shrink tubing that can be snapped apart and used for sample containers if the laboratory will accept them. If the sample is being analyzed for VOCs, the ends of the sections should be immediately covered with either teflon film or aluminum foil and capped. If the acetate liner is being used to collect samples for VOC analysis, the sample should be transferred to the sample container with as little aeration as possible and the container must be packed as air tight as possible. Using brass liners is the preferred method for the collection of VOCs, because of the loss of VOCs in the plastic and during transferring the sample to a glass container.

The Macro-Core sampler is a continuous core sampler. The four-foot sampler can be used as an open tube sampler or a closed-piston sampler. When used as an open tube sampler, a continuous sample is collected in four foot sections from the surface to the desired depth. When used as a closed-piston sampler, a sample is collected from the surface to four foot depth with the sampler used as an open tube sampler. The piston tip assembly is installed on the sampler. The sampler is driven to a 4-foot depth, and the piston tip assembly is released to allow soil to enter the sampler while being driven from the 4-foot depth to an 8-foot depth. The sampler is re-assembled with the piston tip assembly and the process is repeated until the desired depth is reached. **The Macro-Core sampler cannot be advanced through undisturbed soil with the piston tip assembly in place. The system is designed to be advanced with the piston assembly in place through previously open holes only.** If continuous sampling is not desired, a pilot hole may be advanced using a pre-probe.

The Dual Tube method involves advancing a sample tube held in place with smaller probe rod inside 2.125 inch probe rod (rod used to set micro-wells), hence the name Dual Tube. The Dual Tube system can be used to collect soil samples for soil analysis or logging while installing mini wells. Continuous coring can be performed in both saturated and unsaturated zones. Bottom up grouting can be performed while retraction the outer casing.

2.6. Direct Sensing-Soil Conductivity and Membrane Interface Probe

The direct sensing system can be used with the Membrane Interface Probe (MIP) or a conductivity probe. The MIP system is capable of simultaneous measuring soil conductivity and volatile organic compounds. The MIP system components consist of a Gas Chromatograph(GC), MIP control module, string-pot to measure depth, a lap top computer to operate the system and to collect data, and a combination probe containing a membrane contact zone and a conductivity sensor.

The system is operated by running a harness, that contains wiring for the conductivity sensor and tubing for carrier gas to the membrane contact zone, through the probe rods (the harness has to be threaded through enough probe rod prior to connecting up the system to reach the desired depth). The wiring for the conductivity sensor is connected to the control box. The carrier gas tubing is connected to a ultra pure nitrogen tank and goes down-hole to the membrane contact zone. From the membrane contact zone the tubing goes up-hole to the GC and is connected directly to the detector, bypassing the GC column.

When operating the MIP system, the mobile laboratory is parked next to the geoprobe in order to connect the system to the mobile laboratory GC and to run the control module off the mobile laboratory's generator. The MIP system operates with 110 volt electricity.

If only soil conductivity is desired, a conductivity probe is used to save wear and tear on the more expensive MIP probe. The system operates similar to the MIP system without the GC being involved. Since the same control box is used for both systems, either the mobile laboratory or a portable generator is needed for the electrical source.

2.7. Micro-Well Installation

To install micro-wells using a Geoprobe, refer to SOP BER 28.

2.8 Vapor Well Installation

To install vapor wells using a Geoprobe, refer to SOP BER-35.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-08

CHARACTERIZATION AND DISPOSAL OF INVESTIGATIVE DERIVED WASTE

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1. INTRODUCTION

This guidance provides general options for management of investigation-derived wastes (IDW) generated during the investigation of potential or actual contaminated sites. These wastes include soil cuttings, drilling muds, and other materials. The general process for characterization and disposal of IDW is outlined on the attached flow chart. Individual project managers and/or programs may have additional requirements.

2. METHOD SUMMARY

In the process of collecting environmental samples during investigations, field staff may generate many different types of potentially contaminated IDW. This SOP is to be used to assist project managers and field staff in their decision making. Project managers should use EPA Guidance Document EPA/540/G-91/009, "Management of Investigation-Derived Wastes" for additional information concerning disposal of IDW.

3. PROCEDURE

Analysis of IDW should be conducted using KDHE-approved methodologies and technologies. Laboratory analysis should be performed according to EPA SW-846 8000 Series (solids or liquids) or 600 series (waste water). Type and frequency of laboratory analysis should be approved on a site-specific basis by the KDHE Project Manager. Use of field analytical technology is encouraged and should be chosen on a site-specific basis considering the constituents of concern and analytical equipment limitations. Use of field analytical equipment, type and frequency of confirmatory laboratory analysis should be approved on a site-specific basis by the KDHE Project Manager. The appropriate BER SOP should be consulted for sampling methods for actual or potentially contaminated media generated as IDW.

4. GENERAL CONSIDERATIONS

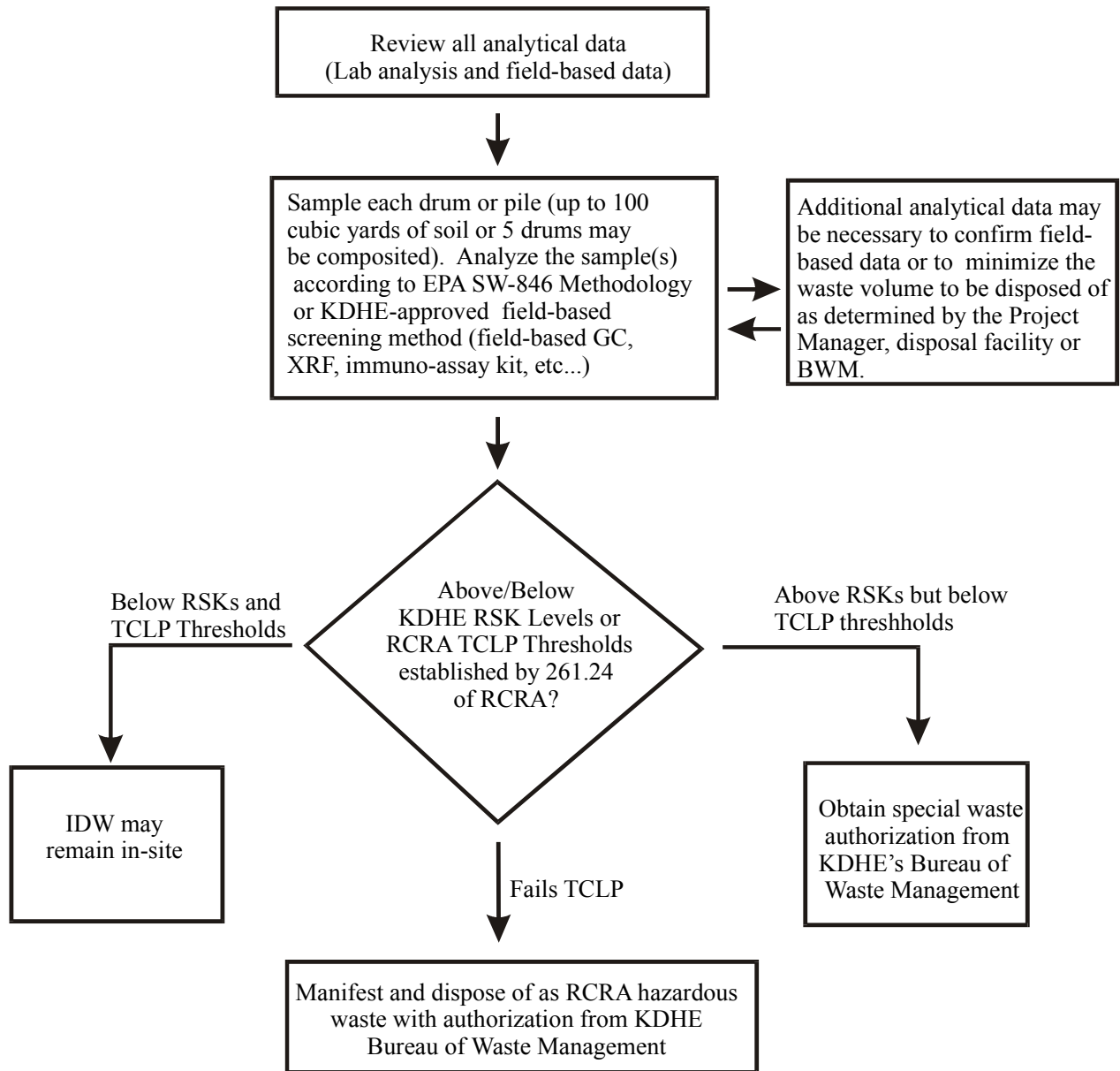
- Leave the site in no worse condition than existed prior to the investigation;
- Remove wastes that pose an immediate threat to human health or the environment;
- Spread evenly on-site IDW that does not require off-site disposal or above-ground containerization;
- Minimize the quantity of IDW to the extent practicable; and
- Comply with applicable clean-up and disposal standards to the extent practicable and as approved by the KDHE Project Manager.

5. SPECIAL CONSIDERATIONS

Disposal of solids must have concurrence of the KDHE's Bureau of Waste Management (BWM). Responsibility of providing necessary BWM documentation and information is upon the party disposing of the IDW. Waste characterization and disposal must be in accordance with applicable State, Federal, and local waste management regulations and standards.

Attachment A

General Solid IDW Disposal Process Flowchart

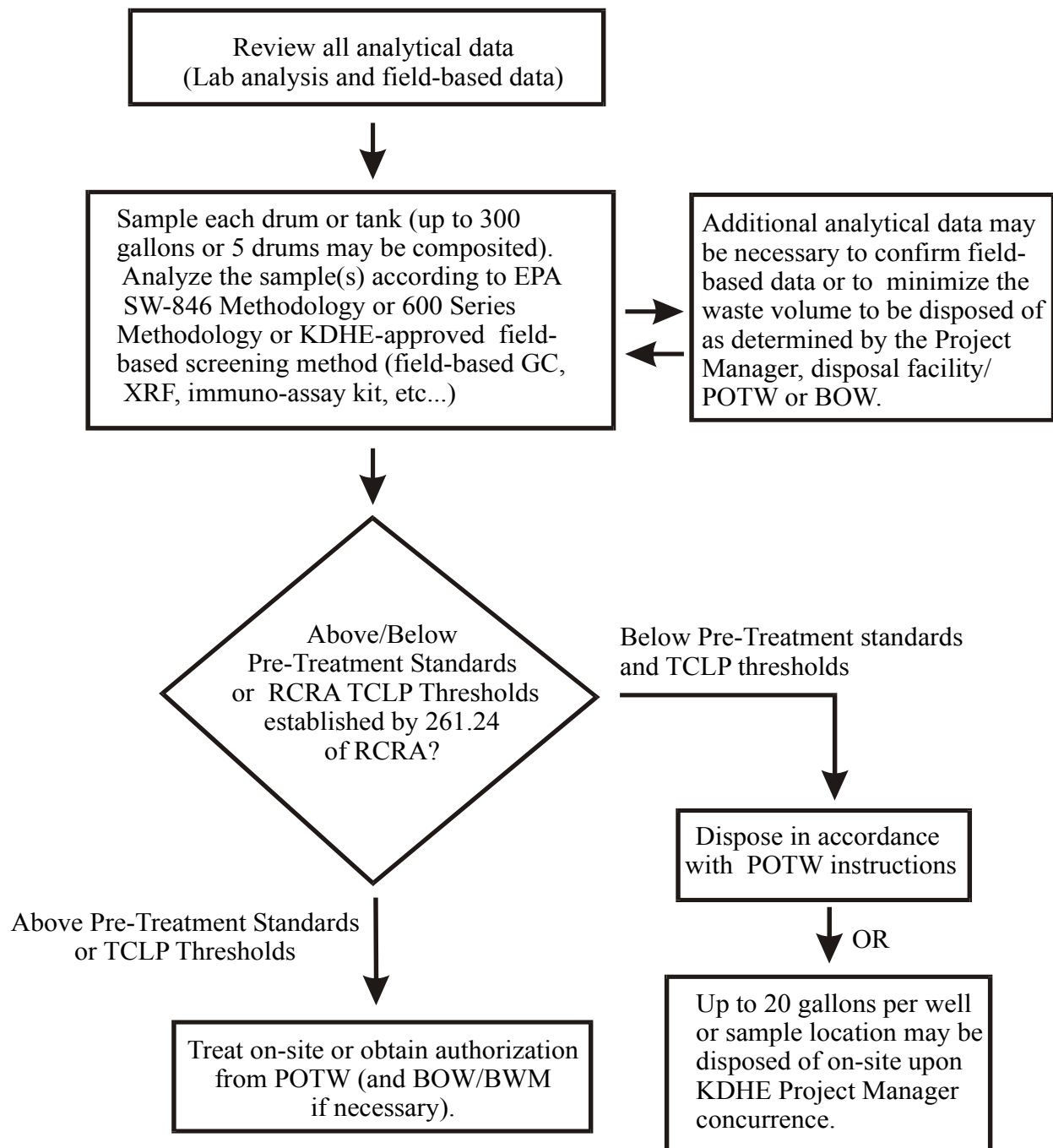


****NOTE:** All site-specific IDW procedures must be approved by the KDHE Project Manager prior to implementation.

All off-site disposal of IDW must have concurrence/approval of KDHE/ Bureau of Waste Management.

Attachment B

General IDW Water Disposal Process Flowchart



****NOTE:** All site-specific IDW procedures must be approved by the KDHE Project Manager prior to implementation.

All off-site disposal of IDW must have concurrence/approval of KDHE/ Bureau of Waste Management or Bureau of Water.

APPENDIX A

STANDARD OPERATING PROCEDURES BER-09

**CONDUCTING A
STEP-DRAWDOWN TEST**

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Attachment A KDHE Pumping Test Form

1. PURPOSE AND OVERVIEW

This document outlines the standard operating procedure (SOP) for a step-drawdown or “step-test” of a single pumping well. Drawdown observed in any pumping well is a result of formation loss (due to laminar and turbulent flow head loss within an aquifer) and well loss (due to the turbulent flow of water into and inside the well). Step-drawdown tests are used to determine the percentage of total head loss in a single well that may be attributed to laminar flow and the specific capacity of a well pumped at various discharge rates. The results of a step-drawdown test may be used to: 1) determine the appropriate pumping rate for a constant-rate (pumping) test; 2) estimate a well’s long-term yield; 3) evaluate a well’s condition or efficiency; and 4) calculate transmissivity and storage coefficient values for the aquifer (from time-drawdown and distance-drawdown graphs plotted from data for one of the constant-rate steps of the step test). Step-drawdown tests are extremely useful in bedrock wells for estimating the depth to the most productive water-bearing fracture zone.

In a step-test, drawdown associated with pumping is examined during several constant-rate pumping intervals. The test usually begins with low discharge rate and the pumping rate is increased to several successively higher rates until well capacity is met. Drawdown is monitored during each step until water levels in the well stabilize. The entire test is usually completed within one day and each step generally lasts less than two hours. Because analysis of data collected during the test is simplified when each pumping interval is of the same duration, constant-rate pumping periods should be of uniform durations. A range of pumping rates should be tested that spans the lowest and highest pumping rates possible in the well. In a typical test, at least three pumping rates are tested and each test lasts one to two hours. If the water level drops sharply during pumping and drawdown approaches its maximum level, the pumping rate will have exceeded the capacity of the formation and the pumping rates of additional tests must be modified accordingly.

2. EQUIPMENT AND MATERIALS

The following items may be necessary for a step-drawdown test:

- (1) Electronic water level recorders
- (2) Steel tape (calibrated in 0.01-foot increments) and chalk (e.g., blue carpenter's)
- (3) Data loggers and pressure transducers
- (4) Field forms (e.g., Daily Log, Aquifer Test Form, Well Inspection Checklist) and site field notebook
- (5) Rain gauge
- (6) Barometer

- (7) Stop watch or watch with second display/hand
- (8) Pump
- (9) Generator and fuel/power supply
- (10) Water-level recorders (e.g., Stevens type)
- (11) Flashlights/illumination
- (12) Stream gauge and/or tide gauge
- (13) Shelter
- (14) In-line flow meter and/or orifice and manometer
- (15) Valve(s)
- (16) On-site holding tanks or tank trucks, or treatment capability
- (17) Discharge line (leak free)
- (18) Water-quality meters (pH, conductivity, temperature)
- (19) Extra batteries (flashlight, meters)
- (20) Non-absorbent cord (e.g., polypropylene)
- (22) Portable personal computer (PC), appropriate cables, software, and floppy disks
- (23) Five-gallon bucket
- (24) Clean cloth or paper towels
- (25) Non-phosphate, laboratory-grade detergent solution
- (26) Distilled or deionized water and potable water
- (27) Discharge approval letter from Bureau of Water
- (28) Personal protection gear as specified in the Health and Safety Work Plan

3. PROCEDURE FOR DECONTAMINATING EQUIPMENT

Any equipment that enters a well should be cleaned and decontaminated according to SOP BER-05 prior to use. New, clean materials should be used when decontamination is not appropriate (e.g. non-absorbent cord and disposable gloves). Decontamination procedures should be documented on the appropriate field forms (e.g., Daily Log) and in the field notebook, and entries should be initialed and dated.

4. PROCEDURE FOR CONDUCTING THE TEST

4.1 PRETEST ACTIVITIES

The following issues should be addressed before the day the test is conducted:

- (1) Estimate the volume of water that will be produced over the duration of the test. Arrangements should be made to dispose of the discharge water in an appropriate manner. If the pumped water is contaminated it may be treated and discharged or transported off site. If discharge water is disposed of on site it must be released at a location far enough away from the site to eliminate possible artificial recharge to the aquifer. Discharge of pumped water at the site may require a permit from the KDHE-Bureau of Water.
- (2) Calibrate any transducers or water-level recorders to be used in the test to allow the full anticipated range of drawdown in the well to be monitored. Maximum anticipated drawdown should be determined to identify the range in water level measurements that may be observed.
- (3) Estimate the maximum capacity of the well and determine the number of steps to be included in the test. The pumping rate for each step may be determined by dividing the difference between the well's highest capacity pumping rate and a low pumping rate by the number of steps desired. For example, if four steps are to be conducted, the pumping rate of each test should be 1/4 of the maximum rate higher than the preceding rate.
- (4) Determine if the well requires redevelopment. Measure and record the total depth of the test well to a measured accuracy of 0.01 foot. Compare the measured depth in the well to that reported in the well construction logs to ensure that appreciable sediment has not accumulated in the well. If the measured well depth differs from that reported on the construction logs, the well must be redeveloped before the test is conducted. The well must respond quickly to changes in water levels, and good hydraulic connection between the well and the aquifer is essential for a reliable test.

- (5) Locate or connect an auxiliary spigot to the discharge line near the wellhead that will allow for the collection of water quality samples.

4.2 CONDUCTING THE TEST

- (1) Set up a rain gauge, continuous recording barometer, and/or continuous recording stream or tide gauge to measure precipitation, barometric pressure and/or surface-water elevation if site conditions warrant monitoring these parameters. If needed, data from these instruments will be used to correct step-test data for changes in groundwater levels associated with recharge from precipitation, barometric pressure, and/or changes in surface-water elevation.
- (2) Ensure that the pumping system selected for the test is properly installed and includes an interruption-free power supply and leak-free discharge line. The discharge line should be properly fitted with an adjustable valve(s), flow meter, or manometer and orifice.
- (3) Complete a Well Inspection Checklist for the well. On the report, note any missing locks, bent or damaged casing(s) or other visible signs of damage to the well. Initial and date the inspection report.
- (4) Complete the top of the Pumping Test Form (attached), and any other relevant field forms. Enter appropriate information in the site field notebook, concerning the well on the Pumping Test Form, appropriate field forms (e.g. Daily Log form) and in the field notebook.
- (5) Measure depth to water in the test well. Measurements should be made from a predetermined measuring point to an accuracy of 0.01 foot. Record these measurements on the Pumping Test Form.
- (6) Determine an appropriate schedule for drawdown measurements. This schedule should be established based on the response (drawdown versus time) of the well to the pumping stress. Measure water-levels (drawdown) to an accuracy of 0.01 foot on a specified schedule. Typically, water level measurements made manually are taken every one minute during the first 10 minutes of the test and every 2 to 5 minutes until the end of the test. If transducers or chart recorders are used, a smaller time measurement interval should be used.
- (7) If pressure transducers will be used during the test, install a precleaned, precalibrated transducer in the test well, connect it to the data logger and verify that the equipment is working. Program the data logger accordingly using the PC and appropriate software.

- (8) If chart recorders will be used during the test, install and calibrate them.
- (9) Synchronize all watches prior to the test if more than one individual is involved in the test.
- (10) If possible, initiate the step test on the hour or half-hour and pump at a constant, low rate (e.g., 25 percent of the estimated capacity determined during development).
- (11) Maintain the pumping rate until the water level approaches or achieves stabilization. This usually, but not necessarily, occurs within one to four hours.
- (12) Compare drawdown measurements made with the automated water-level measuring devices to manual measurements by using an electronic water level indicator and/or a steel tape and chalk. Measurement accuracy should be 0.01 foot. If recorders are used, then "tick" the recorder and document the time next to each "tick" on the chart. Record this data on the Pumping Test form and in the field notebook, and initial and date the entries.
- (13) Measure the discharge rate on a regular basis. This may be done by using a 5-gallon bucket and stopwatch or watch with second display/hand, the in-line flow meter and/or manometer (depending on the set-up and pumping rate). Adjust the valves to maintain a constant discharge rate. Record discharge rates and adjustments (if made) on the Pumping Test form and in the field notebook, and initial and date the entry.
- (14) Measure temperature, pH, and conductivity of discharged water on a periodic, regular basis. Record these values in the comments section on the Pumping Test form and in the field notebook, and initial and date the entries.
- (15) Note any changes throughout the step test that are pertinent to the test such as changes in water color or turbidity, time and length of any temporary pump shut down, effects of any nearby pumping wells, precipitation events, etc. Note the observations in the comments column on the Aquifer Test Form and in the field notebook, and initial and date the entry.
- (16) Once water levels have stabilized, increase the discharge rate to the next pumping rate step. Pump the well at the new rate for the same time interval pumped during the first step. Repeat steps 1 through 15.
- (17) In general, four or more pumping rates of incremental steps follow. Two, three, four,

and greater than four times the initial pumping rate should be used. Actual pumping rates may not exactly match those targeted but it is more important that pumping steps be of equal duration and that a fairly wide range in pumping rates are tested from the first step to the last.

4.3 POST-TEST MEASURES

- (1) Shut down the step test after the last step and/or the capacity of the well has been exceeded, or when sufficient data has been collected to analyze the test. Close the valve closest to the pump as quickly as possible to prevent back flow of water into the pumping well.
- (2) Measure water-level recovery in the wells with an accuracy of 0.01 foot until water levels return as close as possible to pretest levels. The same measurement schedule followed during the drawdown phase of the test should be followed during the recovery phase monitoring. Automated water-level recorders may be left in the test well for several days to monitor water levels for an extended period of time (one or more days) depending on the data collected or data base required.
- (3) If a pressure transducer(s) and data logger were used, transfer the data to the PC on a periodic basis during the test and before monitoring water levels for an extended period of time. This will minimize the possibility that data may be lost and prevent the data logger from overwriting data if the storage capacity of the data logger is exceeded.
- (4) Replace well caps and/or covers on the test wells after the test is completed. Lock the wells if necessary.
- (5) Clean and decontaminate all test equipment that came in contact with the ground water following the procedure outlined in Section 3. Dispose of all materials that were used in the test (e.g., discharge hose, sampler cable, etc. that cannot be decontaminated.

5. REFERENCES

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ATTACHMENT A

KDHE Pumping Test Form

Page ____ of ____

Test date_____

Well#_____

Site name _____

Location_____County_____Township_____Range_____Section_____

Well number/KDHE Well ID _____

Casing stick up height (ft.) _____

Borehole Diameter (in)_____

Casing Diameter (in.) _____

Screened Interval:

Casing material_____

Depth to top of screen (ft)_____

Depth to bottom of screen (ft)_____

Static water level (ft)_____

If Pumping well: Pump type _____ Pump horsepower _____

Average discharge (gpm) _____ Pump depth (ft) _____

Pump On Date: _____ Pump Off: Date _____

Time: _____ Time: _____

If Observation Well: distance from pumping well (ft.) _____

[illegible]

[illegible]

APPENDIX A

STANDARD OPERATING PROCEDURE BER-10

CONDUCTING A CONSTANT-RATE AQUIFER TEST AND RECOVERY TEST

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1. PURPOSE AND OVERVIEW

This document outlines the standard operating procedure (SOP) for a constant-rate aquifer pumping test and an aquifer recovery test. Constant-rate and recovery tests are conducted to measure well performance and/or aquifer hydraulic properties. The tests may be designed for the determination of hydraulic conductivity (K), Transmissivity (T), and Specific Yield (Sy) of unconfined aquifers or Storage Coefficients (S) of confined aquifers. Horizontal and vertical anisotropy and the effects of recharge or barrier boundaries may be also be identified in specifically designed constant-rate tests. Aside from providing information on radial flow, these tests are particularly applicable to bedrock ground-water systems where linear flow may result due to fractures or faults that serve as major conduits for flow.

Throughout a constant-rate pumping test, a constant discharge is maintained at a pumping well and drawdown is measured in the pumping well and a series of observation wells on a preselected time schedule. A continuous record of drawdown is obtained through either manual or automatic water-level monitoring. Although any number of observation wells may be used in a test, observation well selection depends on several factors such as aquifer thickness, distance from the pumping well, and observation well screen position with respect to that of the pumping well. Guidelines for selecting or designing observation wells are presented in Kruseman and DeRidder (1991) and Dawson and Istok (1991).

A recovery test is conducted at the end of a constant-rate pumping test to provide supplemental information on aquifer hydraulics and to confirm the results of the drawdown test. A recovery test allows the impact of fluctuating pumping rate and corresponding drawdown measurements to be eliminated from the analysis of data.

2. EQUIPMENT AND MATERIALS

The following items may be needed for aquifer testing:

- (1) Electronic water level indicator
- (2) Steel tape (in 0.01-foot increments) and chalk (e.g., blue carpenter's).
- (3) Data loggers and pressure transducers.
- (4) Field forms (i.e., Daily Log, Pumping Test, and Well Inspection Checklist) and site field notebook.

- (5) Rain gauge
- (6) Barometer
- (7) Stop watch or watch with second display/hand
- (8) Pump
- (9) Extension cord(s) or generator and fuel/power supply
- (10) Water-level recorders (e.g., Stevens type)
- (11) Flashlight/illumination
- (12) Stream gauge and/or tide gauge
- (13) Shelter
- (14) In-line flow meter and/or orifice and manometer
- (15) Valve(s)
- (16) On-site holding tanks or tank trucks, or treatment capability.
- (17) Discharge line (leak free)
- (18) Water-quality meters (pH, conductivity, temperature)
- (19) Extra batteries (flashlight, meters)
- (20) Non-absorbent cord (e.g., polypropylene)
- (21) Portable personal computer (PC), appropriate cables, software, and floppy disks
- (22) Five-gallon bucket
- (23) Clean cloth or paper towel

- (24) Non-phosphate, laboratory-grade detergent solution
- (25) Distilled or deionized water and potable water
- (26) Discharge approval letter from KDHE Bureau of Water
- (27) Personal protection gear as specified in the Health and Safety Work Plan

3. DECONTAMINATION

Make sure all equipment that enters a well is decontaminated in accordance with Bureau of Environmental Remediation standard operating Procedure BER-05 . Use new, clean materials when decontamination is not appropriate (e.g., non-absorbent cord, disposable gloves). Document, initial and date the decontamination procedures on the appropriate field form (e.g., Daily Log) and in the field notebook.

4. TEST PROCEDURES

4.1 PRETEST ACTIVITIES

- (1) Estimate the volume of water that will be produced over the duration of the test. Arrangements should be made to dispose of the discharge water in an appropriate manner. If the pumped water is contaminated it may be treated and discharged or transported off site. If discharge water is disposed of on site it must be released at a location far enough away from the site to eliminate possible artificial recharge to the aquifer. Discharge of pumped water at the site may require a permit from the KDHE-Bureau of Water.
- (2) If required by the project manager, conduct a step-drawdown (step) test several days before the scheduled constant-rate pumping test to check the performance of the pumping well and establish the pumping rate to be used for the final test (refer to the SOP for conducting a step-down test for the step-drawdown procedure). The pumping rate chosen for the aquifer test will be the maximum rate the well can produce and sustain. Drawdown in an unconfined aquifer should not exceed 25% of the static water level, as this is the largest drawdown that can be reliably evaluated with analytical solutions to groundwater flow equations. Mark the discharge valve for future reference when the appropriate setting has been achieved .

- (3) Verify that selected observation wells will exhibit sufficient drawdown to be included in the test. A trial test should be conducted in which water levels are measured in observation wells while the discharge well is pumped. Additional measurements should be made in several wells that are located outside of the pumping well's radius of influence to allow for approximation of the extent of drawdown that may be observed during the test. Record the pretest water levels for each individual observation well on separate Pumping Test forms.
- (4) Calibrate any transducers or water-level recorders to be used in the test so that the full anticipated range of drawdown in the well may be monitored.
- (5) Determine if the test well or observation wells/piezometers require redevelopment. Measure and record the total depth of the test well to a measured accuracy of 0.01 foot and compare the measured depth in the well to that reported in the well construction logs. If the measurements differ, sediment may have accumulated in the well that could occlude the well screen and cause unexpected variations in the discharge rate or have other effects on the data. The observation well must respond quickly to changes in water levels, and good hydraulic connection between the well and the aquifer is essential for a reliable test. Redevelop the well if necessary.
- (6) Set up recorders and/or install transducers in several, select wells and/or piezometers for an extended period of time (e.g., one week) prior to the test to monitor water-level trends throughout the test area.
- (7) Locate or connect an auxiliary spigot to the discharge line near the wellhead to be used for the collection of water quality samples.
- (8) Identify all production wells in the pumping test area of influence. If possible arrange to have these wells turned off for the test period.
- (9) Obtain as many pretest (non-pumping), water-level reading as possible to evaluate possible fluctuations in water-level. If available, dedicate a member of the field team to collect continuous, water-level measurements on the day of the test, from time of arrival onsite to the start of the test. At least two hours of readings at quarter-hour to half-hour intervals should be collected immediately prior to start-up of the test. If water levels in the aquifer are fluctuating, more readings will be necessary. Water-level fluctuation data may be needed to correct aquifer test data.

- (10) Measure the distance from the pumping wells to each observation well/peizometer and record the distances on Pumping Test forms for each well. Error associated with the measurement of these distances should not be greater than 0.05 % of the measured distances.

4.2 CONDUCTING THE CONSTANT-RATE TEST

- (1) Set up a rain gauge onsite to measure precipitation before, during, and after the test. Monitor the rain gauge on a regular basis, particularly if the tested aquifer is shallow. If precipitation is occurring at the beginning of the test , the test should be postponed until optimum meteorological conditions prevail and water levels, if changing, return to static conditions. If needed, precipitation data collected during the test (after start-up) will be used to correct aquifer test data affected by recharge.
- (2) Set up a continuous recording barometer on site to measure barometric pressure before, during, and after the test. If needed, data from this instrument will be used to correct aquifer test data for changes in barometric pressure during the pumping test.
- (3) Ensure that the pumping system selected for the test is properly installed and includes an interruption-free power supply and leak-free discharge line. The discharge line should be properly fitted with an adjustable valve(s), flow meter, or manometer and orifice.
- (4) Complete a Well Inspection Checklist for each pumping and observation well. Note any missing locks, bent or damaged casing(s) or other visible signs of damage to the well on the forms and initial and date the reports.
- (5) Complete the top section of the Pumping Test Form (attached) and any other relevant field forms for all pumping and observation wells/piezometer that will be included in the test. Enter appropriate information about the test well and observation wells in the site field notebook. Include a sketch map showing the locations of the pumping and observation wells in the field notebook.
- (6) If the test well was pumped prior to the initiation of the test, measure the water level in well to ensure that it is at its non-pumping (static) level. Do not start the constant-rate test until the water level in the well has reached non-pumping conditions.

- (7) If transducers will be used, install a precalibrated and precleaned transducer in the test well, connect it to the data logger, and verify that the equipment is working. Program the data logger accordingly, using the PC and appropriate software.
- (8) Synchronize all watches to be used in the test.
- (9) If possible, initiate the test on the hour or half-hour and pump at a constant rate until sufficient data is collected to allow for analysis. It may take several days or longer to collect the an appropriate amount of data to allow for analysis of the test.
- (10) Turn on the pump and adjust the pumping rate to match that to be used in the test. Use the reference mark on the discharge valve to open the valve the appropriate amount. An in-line flow meter and/or manometer or other approved measurement device may be used for measuring discharge from the well. It is best to use more than one device simultaneously to monitor discharge as a check and a back up. Pumping should not be allowed to vary more than 10% during the test (Walton, 1989).
- (11) Begin measuring water levels immediately on a specified schedule. If manual measurements will be made, the following example schedule may be used. Measurements collected on this schedule will produce a uniform plot of water-level data on a logarithmic scale.

Elapsed Time (minutes)	Frequency of Measurement
0 - 1	Every 15 seconds
1 - 5	Every 30 seconds
5 - 10	Every minute
10 - 30	Every 2 minutes
30 - 60	Every 5 minutes
60 - 120	Every 10 minutes
120 - 180	Every 20 minutes
180 - 360	Every 30 minutes
360 - 1,440	Every hour
1,440 - 2,880	Every 2 hours
2,880 - end of test	Every 4 hours

Measurements should be made as close to the established schedule as possible. This may not be practical without a data recorder. If a reading is missed, the water level measurement should be taken as close to the scheduled time as possible, and the value and alternate time should be recorded on the Pumping Test Form. Initial and date the entries.

- (12) Verify periodically that drawdown measurements obtained with the automated water-level measuring devices are accurate by checking them against manually measured values such as an electronic water-level indicator and/or a steel tape and chalk to an accuracy of 0.01 foot. If a chart recorder is used, add a "tick" mark on the chart and write the time next to each mark.
- (13) Check the discharge rate using the in-line flow meter manometer, and/or other approved measurement device on a regular basis. Adjust the discharge valve if necessary to maintain a constant pumping rate. Record readings and adjustments (if made) on the Pumping Test form and the field notebook, and initial and date the entry.
- (14) Measure temperature, pH, and conductivity of discharged water on a periodic, regular basis. Record data in the comments section of the Pumping Test form and in the field notebook, and initial and date the entry.
- (15) Note any changes throughout the pumping test that are pertinent to the test. These should include changes in water color or turbidity, time and length of any temporary pump shut down, effects of any nearby pumping wells, precipitation events, etc. Document these observations in the comments section of the Pumping Test form and in the field notebook, and initial and date the entry.
- (16) When a member of the field team who has measured water levels manually is replaced by a new staff member, both individuals should measure several water levels together for at least one period of measurement to ensure method consistency during the test. Note the personnel change in the comments section of the Pumping Test form and in the field notebook, and initial and date the entry.
- (17) As time permits, perform a preliminary analysis of the data to determine if the pumping test may be terminated or should be extended. Plot the drawdown verses time data on the appropriate graph paper (semi-logarithmic and/or logarithmic) or on a computer spreadsheet. When possible, correct the water level data before plotting (e.g., for dewatering, barometric efficiency, regional trends, etc.). Use this analysis to determine if the test is producing reasonable results, the appropriate type curves or straight line are generated by the data, the test should be stopped and repeated or the length of the test should be extended.
- (18) Shut down the pumping test when sufficient data has been collected. The pump should be turned off on the hour or half-hour so that recovery starts on the hour or half-hour. Close the valve closest to the pump as quickly as possible to prevent back flow of water into the pumping well.

4.3 RECOVERY TEST AND POST-TEST MEASURES

- (1) Begin measuring water levels immediately after the pump is turned off and until water levels reach or approximate pretest levels. The same measurement schedule used in the constant-rate drawdown test should be followed during the recovery test. Automated water-level recorders should be left in all test wells and/or piezometers during this time if possible as the recovery may last for several days. Measurements should be to an accuracy of 0.01 foot
- (2) Collect at least one final round of water-level measurements after water levels have recovered following the test.
- (3) Replace well caps and/or covers on test and observation wells/piezometers. Lock the wells if necessary.
- (4) Clean (decontaminate) all test equipment that came in contact with the ground water according to the appropriate protocol given in Section 3.0. Dispose of all materials that cannot be decontaminated in an appropriate manner (e.g., discharge hose, etc.).

5. REFERENCES

- Dawson and Istok J. D. 1991, Aquifer Testing: Design and Analysis of Pumping and Slug Tests, Lewis Publishers.
- Driscoll F. G., 1986, Groundwater and Wells, Johnson Division, UOP, INC. St. Paul, Minnesota.
- Nielsen, D. M. ed 1991, Practical handbook of Ground-water Monitoring, Lewis Publishers, Inc., Michigan.
- Stallman, R. W. 1971, Aquifer-test Design, Observation and Data Analysis, U.S.G.S. Techniques of Water Resources Investigations, Book 3 Chapter B1.
- Theis, C. V. 1935, The Relation between the Lowering of the Piezometric Surface and the Rate of Duration of Discharge of a Well using Groundwater Storage, American Geophysical Union Transactions. Vol. 16, pp 519-524.
- Walton, W. C. 1969, Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey Bulletin #49
- Walton, W. C. 1989, Groundwater Pumping Test Design and Analysis, Lewis Publishers.

KDHE Pumping Test Form

Site name _____

Location _____ County _____ Township _____ Range _____ Section _____

Well number/KDHE Well ID _____

Casing stick up height (ft.) _____

Borehole Diameter (in.) _____ Casing Diameter (in.) _____

Screened Interval: _____ Casing material _____

Depth to top of screen (ft.) _____

Depth to bottom of screen (ft.) _____

Static water level (ft.) _____

If Pumping well: Pump type _____ Pump horsepower _____

Average discharge (gpm) _____ Pump depth (ft.) _____

Pump On Date: _____ Pump Off: Date _____

Time: _____ Time _____

If Observation Well: distance from pumping well (ft.) _____

[illegible]

[illegible]

APPENDIX A

STANDARD OPERATING PROCEDURE BER-11

EVALUATION AND VALIDATION OF DATA

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1. INTRODUCTION

1.1 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish the criteria to be followed for documenting and tracking the quality of environmental data generated from field sampling activities. Because valid media-quality data are integral to environmental investigations that characterize site conditions, the quality of the data generated by a field investigation is extremely important to the successful completion of a project. **The level of data evaluation and validation required is determined by the project data quality objectives and must be outlined in the site specific or generic Quality Assurance Project Plan (QAPP).**

1.2 SCOPE

The environmental investigation process is a three phase cycle that includes: (1) Planning Phase, (2) Implementation Phase, and (3) Assessment Phase. This SOP, which is in the Assessment Phase, is used to evaluate and validate data that was generated during the Implementation Phase. The data is validated based on criteria that is established in the Planning Phase.

2. QUALITY ASSURANCE OBJECTIVES

The QAPP must address the following quality assurance objectives that are appropriate for the project. **The degree of data validation depends on the quality of data needed to meet the data quality objectives for the project, which are specified in the QAPP.** Data collected to establish qualitative trends, for example, do not require the same level of validation as data generated to support litigation.

2.1 PRECISION

Precision is the degree to which the measurement is reproducible and is to be determined by comparison of laboratory designated duplicates or designated laboratory matrix spike/matrix spike duplicates. Precision will be calculated as the relative percent difference (RPD) of the two measurements. The equation is as follows:

$$RPD = 100\% \times [Result\ 1 - Result\ 2] \div [(Result\ 1 + Result\ 2) \div 2]$$

2.2 ACCURACY

Accuracy is the degree of agreement between a measured value and a true or known value. Accuracy is evaluated using matrix spike (MS) recoveries, system monitoring compound spike (surrogate) recoveries, or continuing calibration verification (CCV) recoveries. MS samples are samples into which known concentrations of the target compounds of interest have been added (or "spiked"). Surrogate compounds are compounds that behave in a similar manner as the target compounds but are not target compounds and are added (or "spiked") into each sample prior to extraction and analysis. The samples are analyzed by the appropriate analytical method. The result obtained is compared to the known concentration added and the MS or surrogate percent recovery (%R) is calculated. CCV samples are check standards analyzed at intervals not to exceed 12 hours for organic analyses and every 10 samples for inorganic analyses. When matrix spike samples or surrogate compounds are not possible, CCV sample results are used to determine accuracy. Percent recovery is calculated as follows:

$$\text{MS \%R} = 100\% \times [\text{Spiked Result Conc.} - \text{Sample Result Conc.}] \div \text{Spike Conc.}$$

$$\text{CCV and surrogate \%R} = 100\% \times [\text{Result Conc.} \div \text{Known/Spiked Conc.}]$$

2.3 METHOD REPORTING LIMITS

Reporting limits will be based upon method quantitation limits. The procedure for determining the method detection limit for a substance is in Appendix B of Part 136 of Title 40 of the Code of Federal Regulations (40 CFR 136 Appendix B). The method quantitation limit is defined as equivalent to the lowest calibration standard analyzed for each analyte or as ten times the method detection limit.

2.4 COMPLETENESS

Completeness is a measure of the amount of valid, usable data obtained from an analytical data set compared to the amount that was planned to be obtained. Completeness takes into account any breakage, laboratory errors, or sampling difficulties.

$$\text{Completeness} = (\# \text{ of Valid Data Obtained}) / (\# \text{ of Total Planned Data}) \times 100$$

2.5 COMPARABILITY

Comparability expresses the confidence with which one data set can be compared to another. Samples from the same media (i.e., soil, water, etc.) will be considered comparable if the

procedures for collecting the samples are complied with and consistent, if the units of measurement are the same, and if the reporting limits are comparable. In addition to obtaining samples in accordance with approved procedures and in a consistent manner, comparability is assured through the use of laboratories using established and approved analytical methods and protocols. The laboratory's quality control program is designed to establish consistency in the performance of the analytical process. The program includes traceability of measurements to standardized reference materials to establish comparability with other laboratory results, and internal controls to verify consistency of a given laboratory's performance. Standard reporting units (e.g., mg/kg, $\mu\text{g/L}$) will be used for reporting the various parameter results. All data will be subjected to strict QA/QC procedures and reported in a consistent manner to allow for comparison across data sets.

2.6 REPRESENTATIVENESS

The representativeness of the data is the degree to which data represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a function of sample collection and analysis techniques. Data are considered representative if the sampling is performed in accordance with the sampling programs defined in the Field Sampling Plan (FSP) and the analyses meet the requirements outlined in this section and the section on quality control procedures.

3. PROCEDURE FOR DATA VALIDATION

The person designated to validate the data for a project will review the data using the criteria established in the QAPP. The degree of validation of the data depends entirely on the quality of data specified in the QAPP. As a minimum, valid data should be supported with evidence that: (1) all field, laboratory, and other procedures used to collect the data are documented so the work can be reproduced by others skilled in the field; (2) all methods and equipment were working properly when the data was collected; and (3) the methods were capable of producing the values reported and that the precision and accuracy or bias of the data are acceptable for the intended use of the data.

To validate the data for a project, the designated person will:

- (1) Evaluate the quality assurance objectives using the criteria stated in the QAPP. Both field procedures and laboratory procedures will be evaluated.
- (2) Field procedures will be evaluated by examining sample collection procedures and sample handling procedures to determine if the QAPP was followed. To evaluate

sample handling procedures, methods of sample collection, chain of custody forms, sample preservation, and handling of the samples until received by the laboratory, will be examined.

- (3) For laboratory procedures on inorganic compounds, the following may be examined during the validation process:
- Holding times.
 - Instrument calibration, including initial and continuing calibration verification.
 - Blank(s).
 - Laboratory control sample(s).
 - Inductively Coupled Plasma (ICP) interference check samples.
 - Duplicate sample(s).
 - Matrix spike sample(s).
 - Furnace atomic absorption QC.
 - ICP serial dilution(s).
 - Sample result verifications.
 - Field duplicates.
 - General data assessment.
- (4) For laboratory procedures on organic compounds, the following may be examined during the validation process:
- Holding times.
 - Gas Chromatograph/Mass Spectrometer (GC/MS) tuning.
 - GC calibration, initial and continuing.

- Blanks.
 - Surrogate recoveries.
 - Matrix spike/matrix spike duplicates.
 - Internal standards performances.
 - Target Compounds List (TCL) compound identifications.
 - Reported detection limits.
 - Tentatively identified compounds (TICs).
 - Overall system performance.
 - General data assessment.
- (5) The parameters which do not conform to requirements are listed and the data are qualified according to the guidelines listed in the QAPP. The qualified data package is then reviewed and the project data reviewer, the project geochemist and/or the project manager makes a professional judgement concerning the validity of the data package, and its usability for the project.
- (6) This SOP only includes general guidelines. Additional data quality evaluation/validation criteria may be established in a QAPP.

4. REFERENCES

- (1) *EPA Guidance for Quality Assurance Project Plans*, EPA QA/G-5, February 1998.
- (2) *Estimating and Documenting Data Quality*, EPA SOP No. 2110.2C, August 1993.
- (3) *Data Validation Standard Operating Procedures for Contract Laboratory Program Routine Analytical Services*, EPA Region IV, Revision 2.1, July 1999.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-12

**COLLECTION OF QUALITY CONTROL MEASURES
FOR WATER-QUALITY DATA SAMPLES**

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1. PURPOSE

The purpose of this standard operating procedure (SOP) is to explain the quality control (QC) measures taken to ensure the integrity of the samples collected and to establish the guidelines for the collection of QC samples. The objective of the QC program is to ensure that water-quality data of known and reliable quality are developed.

Documentation of representative water-quality data is essential to hydrogeologic investigations; therefore, the data must be validated through the performance of QC sampling. Verification performance sampling is necessary to evaluate and identify contradictory or suspect data. The QC sampling requirements must be determined by the project manager. If data validation protection is specified as part of the hydrogeologic investigation, QC sampling must be conducted.

The laboratory is responsible for the development and implementation of a laboratory QA/QC program. The collection of field QC samples serves primarily as a check to ensure proper field procedures, but can also serve as a mechanism for the laboratory to perform their QA/QC program (such as collecting sufficient sample for the laboratory to perform matrix spike/matrix spike duplicate samples).

2. QUALITY CONTROL SAMPLES

Samples collected for laboratory analysis require the use of quality control samples to monitor sampling activities and laboratory performance. Types of quality control samples may include duplicate and/or duplicate split, trip blank, field equipment blank, matrix spike and matrix spike duplicate, and field matrix spike. A discussion pertaining to each quality control sample follows:

- 2.1 Duplicate and Duplicate Split:** Duplicate sample analysis is performed to evaluate the reproducibility of collection procedures. A duplicate sample is called a split sample when it is collected with or turned over to a second party (e.g., consulting firm) for an independent analysis or submitted to two laboratories for the same analysis. Duplicate samples are two physical samples collected simultaneously from the same location under identical conditions.

A duplicate sample is collected by distributing water from a bailer, pump, or other sampling device back-and-forth from one sample container to the second sample container until the sample containers are filled. Adequate water should be available to fill the sample containers completely before they are capped. If the water is insufficient to fill all the sample containers at once, then incrementally fill each container with water from two or more bailer volumes, pump cycles, etc, until the containers are sufficiently filled. If collecting volatile organic compound (VOC) samples, the 40 ml vial must be filled completely and sealed immediately prior to filling the

second vial to avoid VOC losses. Any deviation from this procedure must be noted, because the laboratory results will not reflect the true VOC value of the sample, if the vial is filled in increments.

For some test substances, water may have to be accumulated in a common container and then decanted slowly into the sample bottles. The work plan should be referenced for a description of how duplicate samples are to be collected. Additionally, in the case of wells that recover slowly and produce insufficient water to fill all the replicate sample containers, the containers should be filled incrementally and kept on ice in the cooler between filling periods.

2.2 Trip Blank: A trip blank sample is a sample of distilled or de-ionized water prepared in the laboratory prior to sampling, and travels unopened in a common container with the sample bottles. (Note: USEPA uses the phrase "demonstrated analyte free water") It is later opened in the laboratory and analyzed along with field samples for constituent(s) of interest to ascertain whether cross-contamination has occurred during field handling, shipment, or in the laboratory. Trip blanks are primarily used to identify "artificial" contamination of the sample caused by airborne volatile organic compounds (VOCs) but may also be used to check for "artificial" contamination of the sample by a test substance or other analyte(s). One trip blank per cooler containing VOC samples, or test substance of other analyte(s) of interest, should accompany each day's samples.

2.3 Field Equipment Blank: A field equipment blank (equipment rinsate) sample is collected to evaluate decontamination procedures. It is a sample of analyte-free media which has been used to rinse reusable sampling equipment and is collected after completion of decontamination and prior to sampling. A rinsate sample would not be collected from a dedicated bailer or a disposable bailer. One equipment blank should be incorporated into the sampling program for each day's collection of samples and analyzed for the appropriate chemicals of concern. In some situations one equipment blank will be required for each type of sampling procedure (e.g., split-spoon, bailer, and auger).

A special type of field blank may be needed where ambient air quality may be poor. This field blank sample would be taken to determine if airborne contaminants interfere with constituent identification or quantification. This field blank sample is a sample bottle that is filled and sealed with "clean" (e.g., distilled/de-ionized/demonstrated analyte free) water in the analytical laboratory, and travels unopened with the sample bottles. It is opened in the field and exposed to the air at a location(s) to check for potential atmospheric interference(s). The field blank is resealed and shipped to the contract laboratory for analysis.

- 2.4 Matrix Spike And Matrix Spike Duplicate:** Spikes of compounds (e.g., standard compound, test substance, etc.) are added to samples in the laboratory to determine if the matrix is interfering with constituent identification or quantification, as well as a check for systematic errors and lack of sensitivity of analytical equipment. Samples for spikes are collected in the identical manner as for standard analysis, and shipped to the laboratory for spiking. Matrix spike duplicate sample collection and laboratory spiking and analysis are performed to evaluate the reproducibility of matrix spike results. Additional sample volume may have to be collected for the laboratory to perform matrix spike/matrix spike duplicate samples.
- 2.5 Field Matrix Spike:** A field matrix spike is performed by field personnel prior to delivery to the laboratory and is used to evaluate the test substance's (analyte) stability between spiking and analysis.

A field matrix spike is prepared by filling the sample container(s) to a predetermined volume and adding a known amount of the spike. This procedure must be performed in controlled conditions to ensure that it is completed accurately without any cross contamination of any samples.

The work plan must be referred to for details regarding the type of QC samples to be collected and the QC sample collection method.

3. PROCEDURE

- (1) Implement QC sampling as outlined above, depending on the type of QC sample(s) specified in the work plan.
- (2) Ensure unbiased handling and analysis of duplicate and blank QC samples by concealing their identity by means of coding so that the analytical laboratory cannot determine which samples are included for QC purposes. Attempt to use a code that will not cause confusion if additional samples are collected or additional monitoring wells are installed. For example, if there are three existing monitoring wells (MW-1, 2 and 3), do not label the QC blank MW-4. If an additional monitoring well were installed, confusion could result.
- (3) Verify that each sample container is properly placed in the cooler, and that the cooler has sufficient ice (wet ice or blue packs) to preserve the samples for transportation to the analytical laboratory. Consult the site work plan to determine if a particular ice is specified as the preservative for transportation (e.g., the USEPA prefers the use of wet ice because they claim that blue ice will not hold the samples at 4° C).

- (4) Document the QC samples on the appropriate field form and in the field notebook. On the chain-of-custody form, duplicate and blank QC samples will be labeled using codes, and matrix spike and field matrix spike QC samples will be identified as such.
- (5) The collection of quality control samples will follow KDHE's SOP BER-01 for the collection of ground water samples.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-13

**HEADSPACE METHOD FOR SCREENING SOIL SAMPLES
FOR VOLATILE ORGANIC VAPORS**

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1. PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for screening soil samples for volatile organic vapors using a portable photoionization detector (PID) or color metric tubes. This SOP is applicable to soil samples collected from geoprobe soil samples, split-spoon samplers during drilling, hand auger samples, and grab samples from stockpiled soils or excavations.

2. CONSIDERATIONS

The primary objective of field screening of soil samples is to obtain a qualitative understanding of the distribution of volatile organic compounds (VOCs) in soil. The proper design of an organic vapor screening program requires an understanding of site hydrogeology, potential source areas, and potential constituents of concern or the type of colorimetric tubes based on the type of contaminant. Sample locations and frequency must be fully defined in the work plan. The work plan should outline the type of lamp to be utilized in the PID based on the ionization potentials and response factors of the constituents of concern. The work plan must also clearly describe the heating or equilibration procedures to be employed if they differ from those described in this SOP. Regardless of the specific equilibration procedure employed, it is imperative that each sample be treated identically to allow the photoionization results from different locations to be compared. Observations such as moisture, soil composition, and organic content should be noted to facilitate interpretation of the data. Every effort should be made to collect a representative portion of soil from the sampling device.

3. MATERIALS/EQUIPMENT

The following material may be used:

- (1) A work plan which outlines field soil screening requirements.
- (2) Decontamination supplies (including: non-phosphate laboratory grade detergent, buckets, brushes, potable water, distilled water, aluminum foil, plastic sheeting, etc.).
- (3) Field notebook, field form(s), maps, chain-of-custody forms.
- (4) Sampling device (split-spoon sampler, stainless steel hand auger, stainless steel trowel, etc.).
- (5) Stainless steel spoons or spatulas.

- (6) Disposable plastic spoons.
- (7) Plastic sheeting.
- (8) Aluminum foil.
- (9) Mason jars or driller's jars.
- (10) Water bath (hot plate, extension cord, water tray, thermometer).
- (11) Photoionization detector with charging unit.
- (12) Calibration gases with regulator.
- (13) Indelible marker.
- (14) Masking tape.
- (15) Disposable sampling gloves.
- (16) Zip lock bags, approximately 1 quart capacity.

4. DECONTAMINATION

Where possible, thoroughly pre-cleaned and wrapped sampling equipment should be used and dedicated to individual sampling locations. Disposable items such as sampling gloves, aluminum foil, and sample jars will be discarded after each use in an appropriate manner. If only field screening results are to be obtained then split-spoon samples and hand augers may be cleaned with a soap and water wash and potable water rinse or steam cleaning, and a final distilled water rinse. However, if samples are to be collected concurrently for laboratory analytical results, then all reusable sampling equipment must be thoroughly decontaminated according to the SOP for decontamination of field equipment.

5. CALIBRATION

The PID must be calibrated according to the manufacturer's specifications at a minimum frequency of once per day prior to the first sample analyzed each day. A calibration standard gas should be employed which is similar to the compounds of concern expected at the site. In addition, periodic calibration verifications (e.g., every 2 hours or every ten samples) employing the standard gas must be conducted. The time, date, and calibration procedure must be clearly documented in the field notebook and the calibration log. If at any time the photoionization results appear erratic or inconsistent with field observations, then the unit must be re-calibrated. If calibration is difficult to achieve, then the unit's lamp should be checked for dirt or moisture and cleaned, as necessary. During humid or wet conditions, the unit should be calibrated on a more frequent basis as determined by field personnel. If colormetric tubes are used, the brand and type of pumps and tubes must be documented in the field notebook. The expiration date, batch number of the tubes and the methods utilized must be documented.

6. PROCEDURE

- (1) Extract the soil sample from the sampler, quickly measure the recovery, and separate the waste from the true sample by using a dedicated, stainless steel spatula. Where allowed by regulatory agency(ies), disposable plastic spoons may be used.
- (2) Place the sample in a pre-cleaned glass jar (as quickly as possible to avoid loss of VOCs) filling the jar half full. Place an aluminum foil seal between the glass and metal cap and screw tight.

Zip lock bags may be used as an alternative to glass jars for sample containers. The bags should be approximately one quart capacity, and should be filled with approximately equal volumes of soil sample and air space. The color coded zip locks which change color to indicate a positive seal should be used if they are available. Seal the sample and air in the bag to avoid loss of VOCs.

- (3) Label jars or bags with the boring number, depth of sample, date and time of collection. In addition, the field personnel will ensure the following: samples are taken at appropriate depths, unrepresentative portions of the sample are discarded properly; all sampling equipment is decontaminated properly between use; and the driller uses proper methods during sample collection and does not use oil or grease on tools entering the borehole.
- (4) Log the sample in detail and record sediment characteristics (color, odor, moisture, texture, density, consistency, organic content, and layering).
- (5) If the ambient temperature during the sampling event exceeds 70° F, the sample may be allowed to equilibrate at ambient temperature for at least five minutes. If the ambient temperature is less than 70° F, the sample temperature should be elevated by placing the sample under gentle heat for at least five minutes. The heater or defroster of a vehicle may be used to heat the sample for the equilibration process.
- (6) Alternatively, a water bath may be used to heat and stabilize the temperature of the samples. The water bath should bring the temperature of the sample to at least 70° F but no more than 100° F for at least two minutes.
- (7) If a PID is to be used, ensure that it has been calibrated and that the calibration information is documented in the field book. Pierce the aluminum foil seal with the probe from the PID or colorimetric tube or insert the probe or tube into a small opening

in the zip lock bag, and measure the relative concentration of VOCs in the headspace of the soil sample. The initial (peak) reading must be recorded.

- (8) Record the instrument reading in the field notebook, on an appropriate field form, and on the base map, if appropriate.
- (9) Place any material not representative of the interval sampled in an appropriate container with the other cuttings from the borehole.
- (10) If only field screening results are to be obtained, then reusable sampling devices may be cleaned with a soap and water wash and a potable water rinse. The sampler will then be rinsed with distilled water, assembled and placed on plastic sheeting for reuse. A more rigorous decontamination procedure is required when samples are also being collected for laboratory analysis. Refer to SOP BER-03 for collection of soil samples for laboratory analysis for additional information.

APPENDIX A
STANDARD OPERATING PROCEDURE BER-14
MINIMUM STANDARDS FOR MODEL USE
(RESCINDED)

APPENDIX A

STANDARD OPERATING PROCEDURE BER-15

**CONDUCTING SOIL VAPOR EXTRACTION
(SVE) TESTS**

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1. INTRODUCTION

The purpose of this SOP is to provide minimum guidelines to be considered during the planning and performance of a soil vapor extraction (SVE) pilot test. The pilot test is usually a short-duration (typically less than eight hours) in-situ soil vapor extraction test that directly measures all pertinent site characteristics and geologic heterogeneities as an inherent part of the test procedure. A pilot test typically involves applying a vacuum to an extraction well or wells, collecting vacuum data, air flow rates, exhaust vapor concentrations, and contaminant compositions at the extraction well(s) while recording vacuum responses at SVE observation wells. Pilot testing is an integral step in determining the feasibility of SVE as an effective remedial technology and designing a full-scale SVE remedial system. It is important that a site assessment be completed in order to adequately delineate area(s) of contamination in saturated and unsaturated zones and ensure SVE pilot test wells are situated in areas of highest contamination. Note that the KDHE project manager may require a site-specific SVE pilot test work plan, and that the nature of SVE pilot tests may vary substantially based on site-specific conditions.

2. SVE TEST OBJECTIVES

The following objectives should be considered when conducting a pilot test to obtain site data on a SVE system design:

- Select existing wells or install new wells for vapor extraction:
 - verify delineation of the vertical and horizontal extent of contamination
 - review completion logs for existing wells (site lithology)
 - review extraction well location(s) relative to observation wells and a preliminary estimation of the anticipated radius of influence (ROI)
 - review extraction well location(s) relative to man-made airflow pathways/barriers
 - review the validity of the well construction for extraction (apron, screened interval based on available static water level (SWL) readings, filter pack and screen size)
 - consider using multiple extraction wells to determine homogeneity of site geology
- Select SVE observation wells:
 - determine whether existing wells are appropriate (screen intervals should be similar to extraction wells) or whether new wells are necessary
 - evaluate the radial orientation to extraction well(s) (Placement is somewhat arbitrary, but generally they should be located about 5 to 10 feet, 10 to 20 feet, 20 to 40 feet and greater than 40 feet (in alluvium) from extraction well)
 - * Note that KDHE prefers a minimum of three observation wells (Incremental steady state pressure data plotted versus the logarithm of the distance from the extraction well is used to graphically determine the ROI; a minimum of three observation points are necessary to effectively define this curve.)

- Establish data collection procedures:
 - Monitor barometric pressure throughout pilot test
 - At the extraction well(s), measure and document
 - vacuum
 - airflow (the use of the blower's performance curve is not acceptable for initial data collection)
 - vapor concentrations, temperature and composition
 - monitoring frequency
 - depth
 - At the observation wells, measure and document
 - vacuum response
 - monitoring frequency
 - depth (several shallow wells should be also monitored during deep SVE pilot test)
- Necessary equipment will include:
 - vacuum pump/blower
 - pressure gauges
 - airflow measurement devices (direct read, pitot tubes, etc.)
 - field monitoring equipment (photo-ionization detector (PID), flame-ionization detector (FID), colorimetric indicator tubes, oxygen meter, etc.)
 - air sampling containers (Tedlar^R bags (or equivalent), summa canisters, etc.) if laboratory analytical is necessary.
- Establish the method and duration of the pilot test prior to implementation:
 - vacuum step tests are encouraged for design purposes (manual dilution valve should be closed until applied vacuum results in air flow, then increased incrementally (e.g., 10 to 20 inches of water)
 - number of steps or pilot tests (i.e., shallow vs. deep) will depend on site lithology
 - steps or pilot tests should be run until pressures reach an equilibrium or stabilize
- Data interpretation should determine:
 - SVE system design parameters (wellhead vacuum, airflow, and ROI)
 - need for off-gas treatment
 - potential for nuisance conditions (remedial equipment noise, odors, etc.)

3. EQUIPMENT

A SVE well should consist of a 2" nominal diameter schedule 40 PVC pipe or larger and be installed in the area of greatest soil contamination concentrations. The well should be drilled using an appropriate diameter hollow stem auger or other approved drilling method (mud rotary and air rotary methods are not recommended for SVE wells), screened appropriately for site conditions and the intended test, and packed with silica sand of appropriate size in the zone of expected volatile organic

compound (VOC) contamination. The extraction well should be constructed in accordance with SOP BER-06 (monitoring well installation). The well should be completed with a locking well cover and a concrete apron.

Where appropriate, a monitoring well or water well may be used for the SVE test well, provided that it is screened at an appropriate level above SWL.

A vacuum blower or pump in the range of 1 to 2 horsepower may be used for the SVE test. It should meet the following criteria:

- Capable of drawing approximately 40 to 50 inches of water vacuum, keep in mind that the inches of vacuum should never approach the inches of available screen, at a flow rate of approximately 30 to 50 cubic feet per minute (cfm) of airflow. The manufacturer's vacuum-flow rate performance data should be available, and the performance curve should be gradual to allow for a wide range of operating flow rates in the range of approximately 15 to 75 cfm.
- Designed for non-sparking, oil-free operation, and suitable for continuous duty.
- Equipped with or adapted to a 2" inlet, 2" outlet, and a vertical discharge stack, allowing discharge at least 6 feet above ground level, to reduce noise and odors in the vicinity of the test. For convenience in taking samples, the discharge stack should be equipped with a valved sample port and a shutoff valve to direct air pressure into the sample containers.
- Equipped with a water knockout drum.

Observation wells (preferably three or more) should be present, at various distances from the SVE test well, up to approximately 25 to 50 feet. The observation wells may be any convenient diameter, but should be installed with construction and screened intervals similar to the extraction well. The observation wells will be capped or sealed so that no substantial air flow is permitted into the wells during the test.

Vacuum gauges should be provided for the observation wells, but may be moved among several wells. The ranges of the vacuum gauges must be selected to permit vacuum readings from approximately 0.05" water to approximately 20" water, with 3% accuracy. A vacuum gauge having a range of at least 75" of water should be provided for the test well.

4. METHODS

Preliminary measurements should include the following:

- Distance from the test well to each observation well.
- Screened interval for each well.
- Barometric pressure and ambient air temperature.
- Time at the start of the test.
- Initial readings of all pressure/vacuum gauges. If a correction to any of the gauge readings is required, it should be noted in the field book.

When the vacuum blower is started, note the time and sample the discharge for VOCs using a PID, OVA, colorimetric indicator tubes, or explosimeter. The discharge should be re-sampled hourly for explosive or hazardous vapors. Note the vacuum readings at all wells at least hourly. If possible, a constant vacuum should be maintained at the test well. The flow rate of the vacuum blower may be estimated from the observed vacuum using the performance curve once initial readings have been established. The project manager may require direct measurement of air flow from the blower. If the blower must be regulated to maintain a constant vacuum, it should be throttled at the discharge stack. Throttling the suction side of the blower will invalidate the performance curve relationship that is used to determine air flow rate.

5. SAMPLING

At least three samples of the test well discharge should be taken approximately ten minutes after the test begins, midway through the test, and prior to the termination of the test. At sites that are adequately characterized, field screening for contaminants may be appropriate. The Project Manager should be consulted to determine if laboratory samples are needed. Samples, for laboratory analysis, may be taken by either of two methods:

- A. A vacuum pump may be used to withdraw a sample from the wellhead and pump it into a Tedlar^R sample bag (or equivalent), or
- B. The discharge stack may be briefly and partially closed to force the sample into a Tedlar^R sample bag (or equivalent) through the sample port.

The duration of the test should be approximately 4 to 6 hours, and at least long enough to purge one or more volumes of air from the estimated radius of influence. Vacuum readings in all of the observation wells should stabilize prior to terminating the test.

6. QUALITY ASSURANCE/QUALITY CONTROL

Standard monitoring well practice and procedures must be used for drilling and installing the SVE test wells and observation wells (see BER-06) and for contaminant sampling in order to prevent introduced contamination or cross-contamination in the wells or samples. The laboratory samples for VOC levels in the test well discharge are intended only for qualitative estimates of the location and intensity of the contamination in the vicinity of the SVE test well. For these reasons, no QC blanks or duplicate samples are required.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-16

HORIBA U-10 WATER QUALITY ANALYZER

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1. INTRODUCTION

The U-10 Water Quality Analyzer is an instrument for simultaneous multi-parameter measurement of water quality. The U-10 measures water samples for: pH, conductivity, turbidity, dissolved oxygen (DO), temperature, and salinity.

The key to accurate measurements with the U-10 is cleanliness and frequent calibration. It is essential to clean the U-10 thoroughly after each measurement, and it is recommended that the U-10 be calibrated at the minimum before each measurement session. The U-10 can be easily calibrated using the autocalibration procedure which will be described in this document. The manual calibration procedure is more accurate but requires more time and is not conducive to being performed in the field. The instructions for performing the manual calibration are found in the instruction manual.

2. AUTOCALIBRATION

- A. Fill the calibration beaker to the line with the pH standard solution. If the unit has not been used for a period of time, carefully remove the protective rubber cap from the pH sensor. Fit the probe over the beaker which is shaped to prevent the DO sensor from being immersed in the standard solution.
- B. With the power on, press the MODE key to put the unit into the MAINT mode. The lower cursor should be on the AUTO Sub-Mode; if it is not, use the MODE key to move the lower cursor to AUTO.
- C. Press the ENT key. The readout will show CAL. Wait a moment, and the upper cursor will gradually move across the four autocalibration parameters one-by-one. When the calibration is complete, the readout will briefly show END and then will switch to the MEAS mode. The upper cursor will blink while the auto calibration is being made. It will stop blinking when the calibration is stabilized.
- D. After the DO calibration, if the unit does not switch to the MEAS mode and the readout shows either Er3 or Er4, an autocalibration error has occurred. Redo the autocalibration. Press the CLR key to cancel the error code. Then press the ENT key to restart the calibration.

3. MAKING MEASUREMENTS

- A. Turn the power on. The U-10 should be in the MEAS mode.
- B. Gently place the probe into the water sample. To get a uniform reading, slowly move the probe up and down to circulate the water through it. Wait for the readout to stabilize while doing this.
- C. When the unit is first turned on, the readout will have all the LCD segments activated. After about two seconds, the readout will change to show a new measurement. The readout will display the last parameter that the upper cursor was on when the previous measurement was made. Use the SELECT key to toggle the upper cursor to the desired parameter(s).
- D. The EXP key toggles the readout back and forth between standard and expanded display. The expanded mode displays one additional decimal place.

4. DATA STORAGE

The U-10 can store up to 20 sets of data of the values measured for each of the six parameters. The values stored in memory can be recalled to the readout as desired.

To store data:

- A. Press the MODE key to put the U-10 in the MAINT mode. Continue to press the MODE key to move the lower cursor to IN, the Input Sub-Mode.
- B. Use the SELECT key to move the upper cursor to the parameter you wish to see on the readout.
- C. When the readout stabilizes on a value, press the ENT key. This will store the set of six parameters into memory one-by-one from pH to salinity. Each time the ENT key is pressed a set of data is stored.

To recall data:

- A. Press the MODE key to put the U-10 in the MAINT mode. Continue to press the MODE key to move the lower cursor to OUT, the Output Sub-Mode. The readout will read d 1, meaning Data set No. 1.

- B. Use the Up/Down keys to display the data set number of the values you wish to view.
- C. Use the select key to move the upper cursor to the parameter you wish to view.
- D. Press the ENT key to display the data on the readout. When the ENT key is pressed again, the next data set number is displayed.

Deleting data:

- A. Press the MODE key to put the U-10 in the MAINT mode. Continue to press the MODE key to move the lower cursor to IN. Erase all the data from all the data sets by pressing the CLR key. CAUTION: This deletes all the stored data. Single data sets cannot be deleted.

5. MAINTENANCE

Storing the U-10 for a week or less:

After washing the probe thoroughly with clean tap water, fill the calibration cup with tap water and fit the probe over it.

Storing the U-10 for longer periods of time:

The pH sensor must always be kept moist, so fill the small rubber cap with water and use it to cover the pH sensor.

The KCl solution in the reference sensor may seep out. Place vinyl tape around the O-ring portion to help prevent this.

Remove the battery from the main unit, if the unit is stored for a prolonged period of time.

Error Codes:

Er 1	Bad battery	Replace battery
Er 2	Failure in main unit	Contact dealer
Er 3	Zero calibration error	Recalibrate
Er 4	Span calibration error	Recalibrate
Er 5	Memory full	Delete data from memory

APPENDIX A

STANDARD OPERATING PROCEDURE BER-17

**IMPLEMENTING A SPECIALIZED OCCUPATIONAL
HEALTH EXAMINATION PROGRAM**

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1.0 OBJECTIVE

To assure that all Departmental employees who are assigned to field investigative tasks requiring the potential use of Level C personal protective equipment (coveralls, gloves, boots, head protection and negative pressure respiratory protection) or any higher level of protection that includes the wearing of negative pressure respirators are physically capable of utilizing the assigned protective equipment extreme temperatures and physically demanding work situations. Additionally, to monitor for potential long term exposures to common chemicals of interest which may be encountered by staff in the field.

2.0 PROGRAM SCOPE

It is the general policy of the KDHE/BER to prevent employee exposures to hazardous conditions and agents, where possible, through the use of appropriate engineering controls, work practices, and personal protective equipment. The use of certain items of personal protective equipment such as negative pressure respirators increases physical demands upon employees above those associated with normal agency field investigative work. Of particular concern is the general state of health of the individual assigned to use these devices such that the safety and health of the individual is not compromised nor work function impaired. Positions have been identified throughout the bureau in which the wearing of negative pressure respiratory protective equipment is a necessary requirement. Employees assigned to these positions will be required to complete a baseline health examination. In addition to the baseline examination, the health status of each individual in these positions will be reviewed annually with the employee. Follow-up examinations may be required depending upon the findings of the annual interview.

3.0 PROCEDURES

Employees participating in this program will be scheduled by the KDHE/BER for the completion of a baseline or annual examination. This examination will be completed by a designated contractor and may consist of the following services and procedures:

- A. The completion of a thorough health and occupational history with special attention to conditions that may affect the capability of the individual to wear a fullface, negative pressure respirator; assessment of vital signs, hearing and vision screening, and spirometry (with FVC and FEV1.0); examination to emphasize cardiovascular, pulmonary, and integumentary systems; and a written report of findings documenting the capability of the individual to use fullface negative pressure respirators and noting any special limitations of the individual (such as the use of prescription eyewear) which should be known to the Department prior to assignment of job tasks requiring the use of fullface respirators.

- B. Electrocardiogram - 12 lead (resting)
- C. Chemistry Profile
- D. Urinalysis with microscopic examination
- E. CBC with differential
- F. Chest roentgenogram (to be included only if considered appropriate by the examining physician based upon the findings of the health and occupational history and spirometry)
- G. Heavy metal blood scan

Employees will have the option of completing a comparable examination with a physician of their choosing; however, such an examination will be at the employee's expense.

4.0 RECORD KEEPING

The KDHE/BER will be responsible for the cost of the baseline and annual examinations completed by the selected contractor and will provide transportation to and from scheduled examination appointments. The results of detailed health examinations will be maintained on file by the contractor and the summarized written report of findings will be mailed to and maintained on file in the personnel files of the employees examined. Invoices will indicate the names of the individuals receiving examinations and the specific services provided.

APPENDIX A
STANDARD OPERATING PROCEDURES BER-18
FIELD SAFETY PROTOCOL

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1. INTRODUCTION:

This document was developed primarily for unknown hazardous substance sites where a site-specific health and safety plan may be required. This document should not be applicable to sites where routine operations such as monitoring, inspecting or overseeing are conducted. A general Health and Safety Plan may be used for these types of operations.

The handling and sampling of contaminated materials (i.e. hazardous substances, hazardous waste, soil, groundwater) always poses a certain degree of hazard. The objective of this document is to serve as a guideline for the safety of Kansas Department of Health and Environment\Bureau of Environmental Remediation (KDHE\BER) personnel while conducting field activities. This document does not replace a generic or site-specific health and safety plan which should be completed for all site investigations. Program Managers may elect to develop a generic site health and safety plan for programs that conduct similar/routine events. This document does not serve as an SOP for emergency response. Emergency response encompasses an enormous amount of variables specific to emergency response situations. Emergency response documents should be consulted for further details.

2. REQUIREMENTS FOR FIELD PERSONNEL:

Before going on any potentially hazardous waste site or collecting any hazardous samples, BER personnel must have completed an OSHA approved 40 hour hazardous worker course and be enrolled in a medical monitoring program.

3. RESPONSIBILITY OF PROJECT MANAGER/ ONSITE COORDINATOR:

During on-site investigations involving the sampling or handling of hazardous waste, safety precautions must be paramount to all other considerations. Due to the variety of chemicals and their varied toxicities, exposure prevention must be a high priority of the project manager. Despite thorough preparation, a field team may not have adequate knowledge of site conditions. It is impossible to anticipate every hazard that could arise. The project manager or on-site coordinator should consult all available information prior to the field activity to review potential hazards and safety precautions.

In all considerations related to safety, the project manager or on-site coordinator is responsible for:

- * overseeing the collection and organization of site data in order to properly assess the hazard potential;
- * implementing the generic or site-specific health and safety plan;

4. RESPONSIBILITY OF THE SITE SAFETY OFFICER

Some sites will have a separate designated Site Safety Officer who will most often generate and supervise the execution of the generic or site-specific health and safety plan. For most sites, the project manager or on-site coordinator will be the Site Safety Officer. Additional responsibilities may include:

- * ensuring that all team members are familiar with the site safety plan including the route from the site to the chosen medical facility before any site activities begin;
- * conducting site safety briefings, document all on-site safety concerns and situations;
- * maintaining safety equipment in good condition and proper working order;
- * see that safety equipment is used in accordance with the manufacturers instructions and bureau SOPs;
- * see that team members refrain from activities that would create additional hazards (e.g. smoking, eating on site).

5. TYPES OF EXPOSURE TO HAZARDOUS WASTE:

In order to assure the safety of the field team, exposure to hazardous materials must be protected against. The purpose of the following information is to provide some basic insight into the manner by which harmful materials may enter the body. These are four basic types of exposure: inhalation, skin absorption, ingestion, and eye contact.

5.1 INHALATION

Breathing a gas vapor, mist, fumes or dust is the most common accidental form of exposure and this route of entry is the most likely cause of systemic illness. The inhalation hazard depends on a number of factors: the chance that the chemical encountered will leak into the air; the concentration present in the air; the volatility of the chemical at ambient temperature; the inherent toxicity of the chemical; and the length of time the chemical is breathed.

The field team should take the following precautions when entering a site with unknown hazards and/or when sampling from containers, including wells, where the contents pose an inhalation hazard:

- * approach the area, well or container from an upwind position;
- * sample only in well ventilated areas;

- * use the appropriate respirator based on chemical toxicity data and on-site monitoring data; and
- * when appropriate, use an appropriate air monitoring instrument to screen the well/area for volatile vapors.

5.2 SKIN ABSORPTION

Certain chemicals have the capacity to penetrate the unbroken skin (including highly absorbent eye tissue) and are picked up by the blood stream and distributed throughout the body. Skin and eye absorption is probably the second most common accidental means of entry of chemicals into the body. A combination of gloves, boots, hats, coveralls and proper respirator should be worn to protect against skin exposure and absorption. Although no clothing is absolutely impermeable to chemical penetration, certain clothing types are relatively impermeable. These types will be discussed later. In addition to donning proper safety clothing and equipment, the following precautions should be used in inspecting sites which may contain materials hazardous by skin or eye tissue absorption:

- * ensure that all skin areas are protected during site work;
- * when taking samples, carefully wipe all residue off the containers after filling them with the sample;
- * after completing the investigation, use proper procedures for removing contaminated clothing while still at the site;
- * contaminated rags and other disposable items, such as gloves, should be bagged for proper disposal, avoiding skin contact. Gloves should be the last piece of personal protective gear to be removed;
- * the hands and facial area should be washed before leaving the site or as soon as possible after leaving the site.

5.3 INGESTION

Toxic amounts of hazardous material may be carried to the mouth when drinking, eating, or smoking. Therefore, these activities should never be carried on during investigations or after investigations until decontamination procedures have been completed. Furthermore, liquids should not be pipetted or siphoned by mouth under any circumstances.

5.4 EYE CONTACT

The eyes may be harmed by chemicals in either the liquid or vapor form. Irritant effects vary in degree from mild to severe. Some chemicals have the ability to injure the eye to some degree with

surface contact. Eye tissue is also highly absorbent and can not only be damaged but can provide a direct path to the blood stream. The generic or site-specific health and safety plan will describe precautions that should be taken upon entering a site where a contaminant in gas, vapor or liquid form may come into contact with the eyes.

6. INITIAL HAZARD ASSESSMENT:

In conducting investigations of potential hazardous waste sites a detailed hazard assessment must be done before a site specific safety plan can be generated. The procedures outlined below should be followed to varying degrees for all BER sites where BER personnel will actually be on the site.

The hazard assessment will be used to determine whether to enter a potentially hazardous waste site and to determine the appropriate level of protective equipment to be worn when entering. The following section is a describes the logic used for the assessment of hazards at a site.

In order to minimize the potential of exposure to a hazardous substance the following precautions should be considered in the planning stages and observed during the field activity for any site work. The degree to which these precautions are executed is dependant on site specific variables including site/contaminant history and potential exposure risk.

- * prior to on-site arrival, a thorough file/historical review must be completed to examine former as well as current practices conducted at the property including information on known or suspected use of chemicals. The review should include information available from outside sources including local libraries, historical societies interviews etc.
- * review available toxicological information (Condensed Chemical Dictionary, Pesticide Handbook, etc.) to evaluate exposure risks;
- * after reviewing the available environmental and toxicological information, choose protective clothing according to the following guidelines:

KDHE employees should not be exposed to Level A or Level B conditions. If unplanned Level A or Level B conditions are encountered in the field, KDHE employees will withdraw immediately and contact a qualified contractor to complete the task.

- | | |
|---------|---|
| Level A | Provides the highest level of respiratory and skin/eye protection. This degree of protection is to be worn only by trained personnel. The total encapsulation provided by Level A is worn when site operations involve a high potential for splash, immersion, or exposure to unexpected, or known high concentration, vapors, gases, or particulates of materials that are harmful to skin/respiratory system, or can be absorbed through the intact skin. |
|---------|---|

- Level B: Should be selected when the highest level of respiratory protection is needed, but a lesser degree of skin protection. Level B protection is the minimum level recommended on initial site entries when no information exists on the contaminant or its concentration (unknowns) until the hazards have been further defined by on-site studies. If a site history study reveals a need for Level B protective wear the site should be reassessed by the project manager and section chief. If an on-site situation reveals a need for Level B protection the field team is to immediately evacuate to a safe distance and contact his/her section chief for further instructions. Use of Level B protection in BER is only approved for use by emergency response personnel.
- Level C: Should be selected when the type(s) of airborne substance(s) is known, the concentration(s) is measured, and the criteria for using air-purifying respirators are met.
- Level D: Should not be worn on any site with suspected or known respiratory or skin hazards. Level D is primarily a work uniform providing minimal protection.

6.1 GUIDANCE ON SELECTION CRITERIA

Level C protection is distinguished from Level B by the equipment used to protect the respiratory system. Assuming the same type of chemical-resistant clothing is used. The main selection criterion for Level C is that conditions permit wearing air-purifying devices.

The air-purifying device must be a full-face mask (MSHA/NIOSH approved) equipped with an approved canister or cartridges. Canisters or cartridges must be matched to the brand of mask as well as the contaminant in order to remove the substances encountered. Quarter- or half-masks are very limited use masks and should be used only with the approval of the Health and Safety Officer or Project Manager.

In addition, a full-face, air-purifying mask can be used only if:

- * oxygen content of the atmosphere is at least 19.5% by volume;
- * substance(s) is identified and its concentrations) measured;
- * substance(s) has adequate warning properties;
- * individual passes a qualitative fit-test for the mask.

An air monitoring program (using a PID or similar detector) should be part of all field operations when the potential for atmospheric contamination is present. Continual surveillance using direct-reading instruments is needed to detect any changes in air quality necessitating a higher level of

respiratory protection. A background ambient air measurement must be recorded before the field team enters the work area.

Total unidentified vapor/gas concentrations from background to 10 ppm above background must be constantly monitored for changing concentrations. All activity should be conducted from an upwind position from the suspected source. Concentrations of 10 ppm to 20 ppm above background require the use of Level C protection including a full face respirator. An unidentified gas/vapor concentration of 20 ppm above background requires at least Level B protection; if these conditions occur, KDHE employees should withdraw immediately and contact a qualified contractor to complete the task.

Level D protection is primarily a work uniform, providing no special respiratory or splash protection. It can be worn in areas where: 1) only boots can be contaminated, or 2) there are no toxic fumes or gases in the breathing zone.

Before allowing entrance to the site, the project manager should determine if there is an imminent or potential breathing or skin contact hazard and/or risk to health and safety. In such cases, entry is totally inadvisable, and the project manager should withdraw from the area and contact his/her supervisor.

If explosivity meter readings greater than 20% but less than 50% LEL (lower explosive limit) are detected, a very careful survey of the area, including ground, waist, and head level readings, should be made. Readings approaching or exceeding 50% LEL are cause for immediate withdrawal of personnel. The fire department and supervisor should be notified. If the source of the readings is not known, even though the readings are less than 50%, KDHE employees should withdraw and evaluate the safety of the site.

Areas exhibiting high levels of chemical vapors should also be avoided. If extremely dangerous levels are suspected, the field team should not proceed with the investigation.

7. EMERGENCY TREATMENT:

Before entering a site, it is recommended that the project manager and field team know the locations and emergency telephone numbers of the nearest medical facility, ambulance service, fire department, police department and poison control centers. This information, including a map with the directions to the hospital, should be included on the site specific safety plan. In case of any emergency, appropriate assistance should be called immediately and the appropriate emergency treatment conducted.

KDHE/BER personnel who frequently perform field activities should be trained in CPR and basic first aid. A first aid kit with a first aid manual should accompany each KDHE vehicle. The purpose of emergency treatment is to obtain relief and to prevent further damage until professional treatment is obtained. Always notify or have someone else notify emergency medical professionals immediately. First aid procedures for contamination or poisoning by hazardous materials consist of removing, diluting or slowing the movement of the poison. Some knowledge of the hazardous

material combined with prompt treatment is essential in reducing the poison's concentration. Accidents such as a fall or heat stroke could also require emergency treatment. For these measures and other emergency information, consult the on-site first aid manual.

The following are examples that may be listed on a site specific safety plan.

EMERGENCY CONTACTS

<u>Organization</u>	<u>Division</u>	<u>Hours</u>	<u>Telephone</u>
Association of American Railroads	Emergency Response	24-hour	(202) 293-4048
CHEM TREC	Chemical Emergencies	24-hour	(800) 424-9300
Poison Control Center	24-hour Consult White Pages of Local Telephone Directory Under "Poison Control" or National Clearinghouse for Poison Control Centers Directory (U.S.H.E.W.)		
KDHE			(785) 296-1660
EPA Emergency Response		24-hour	(913)281-0991
Kansas Highway Patrol		24-hour	*47-Cell Phone

8. SAFETY EQUIPMENT

8.1 FIRST AID KITS

First aid kits should be available on every KDHE site and can be found in the vehicle. The first aid kit should have an accompanying manual. These kits are for basic first aid problems and are not intended to substitute for professional medical care. The kits should be inspected periodically and restocked as needed.

8.2 RESPIRATORY PROTECTION

Refer to SOP BER-22.

8.3 PERSONAL EQUIPMENT:

All field personnel are required to wear steel toed safety boots on site and be issued a hard hat and safety glasses. The need for a hard hat and safety glasses should be addressed in the site specific safety plan.

8.4 EMERGENCY RESPONSE:

In response situations requiring either a self-contained breathing apparatus or a supplied air device, responders must complete a detailed, documented hazard assessment before entering a hazardous area in order to be properly protected, or should seek the expertise of a trained response team and defer entry to that response team. Refer to emergency response documents for specific details.

9. VEHICLE SAFETY

All vehicles used for field activities will be kept in sound/safe mechanical condition and contain the following safety items: (1) first aid kit (with manual), (2) flashlight, and (3) road hazard kit (emergency flares, triangles, battery jumper cables).

Vehicles should be inspected for the presence of these supplies before departing the office. If the vehicle on site is positioned in such a way as to present a traffic hazard to the vehicle, passing vehicles or persons working around the vehicle, traffic cones will be set to redirect traffic around the work zone.

APPENDIX A

STANDARD OPERATING PROCEDURES BER-19

CHAIN OF CUSTODY

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1.0 INTRODUCTION AND OVERVIEW OF CHAIN OF CUSTODY PROCEDURE

Standard Operating Procedure (SOP) BER 19: Chain of Custody documents the protocol used in the transfer of environmental samples to another person or an analytical laboratory. This SOP is intended to facilitate consistency among staff members, serve as a reference and training tool, and provide a formal written record of the method used to transfer custody of a sample in an environmental monitoring program.

Due to the evidentiary nature of samples collected for investigations, the possession of samples must be traceable from the time the samples are collected until they have been introduced as evidence in legal proceedings. After collecting the samples and labeling the appropriate sample containers, all samples shall be maintained under chain of custody procedures. Each person involved with collecting the samples must know chain of custody procedures.

2.0 CHAIN OF CUSTODY PROCEDURES

To maintain and document sample possession, the following chain of custody procedure should be followed.

2.1 CRITERIA FOR SAMPLE CUSTODY

A sample is under custody if:

- (A) It is in the sampler's actual possession; or
- (B) It is in the sampler's view, after being in his/her physical possession; or
- (C) It was in the sampler's physical possession and then he/she locked it up to prevent tampering; or
- (D) It is in a designated and identified secured area.

2.2 FIELD CUSTODY CONSIDERATIONS

- (A) The number of persons handling the samples should be as few as possible.
- (B) The person who collected the samples in the field is responsible for the care and custody of the samples until they have been transferred or properly relinquished.

2.3 TRANSFER OF CUSTODY AND SHIPMENT

- (A) Samples must be accompanied by a sample submission form that contains a custody record. Sample submission forms are specific to the laboratory where the samples will be submitted for analysis. Hence, the specified sample submission form for Division of Health and Environmental Laboratory (DHEL) analysis, KDHE outside contractor laboratory analysis, or in-field analysis should be used. The custody record on the sample submission form documents the transfer of custody for the samples from the person collecting the sample to another person or to a permanent laboratory. In transferring the possession of samples, the person relinquishing the samples and the person receiving them will sign and date the sample submission form.
- (B) All packages containing samples should be accompanied with sample submission forms identifying their contents. The original form should accompany the shipment, and a copy should be retained for permanent documentation by the person currently in custody of the samples.
- (C) If samples are shipped by a common carrier, a bill of lading should be used. Receipts for bills of lading should be retained for permanent documentation by the person currently in custody of the samples.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-20

GUIDELINES FOR SAMPLING HAZARDOUS MATERIALS

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1. INTRODUCTION

Hazardous materials must be sampled and characterized for disposal, bulking, recycling, grouping, and/or classification purposes. In general, sampling of hazardous materials requires the collection of samples that are adequate in size and representative of the wastes. Waste characteristics, properties and site-specific sampling conditions are highly varied. Therefore, the following standard operating procedure (SOP) gives general considerations for the sampling of hazardous materials. Safety is the primary concern of any hazardous materials operations, and the appropriate personal protective equipment (PPE) should be selected prior to initiating any hazardous materials operations.

2. METHOD SUMMARY

This SOP is to be used to assist project managers and field staff in sampling activities. This SOP does not take the place of a generic or site-specific Sampling and Analysis Plan (SAP) which should consist of two (2) parts: (1) the Quality Assurance Project Plan (QAPP) and (2) the Field Sampling Plan (FSP). A site-specific Health and Safety Plan (HSP) is required for all on-site work under this SOP.

Some general considerations prior to sampling include:

- Review available information about the site and the potential hazardous materials to be sampled.
- Determine appropriate level of PPE to sample the potential materials to be encountered.
- Select appropriate sampling equipment (non-sparking, non-reactive, etc.) as appropriate.
- Select appropriate sample containers based on desired analyses.
- Conduct a reconnaissance of the site to determine access points, sampling equipment needs and potential safety hazards.

The SAP should be followed for specific sampling methods and equipment at a particular site. Safe operating techniques and sampling methods should be used at all times. If necessary, the Project Manager should refer to Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) standards and guidelines for assistance. Special work environments (heavy equipment, confined space, etc.) involve special site-specific

safety and sample methodology/equipment considerations by the Project Manager.

3. PROCEDURE

Hazardous materials can be multi-phase mixtures and can occur in various containers, pits, lagoons, etc. Again, because of the variety of hazardous materials containers, the site-specific SAP should detail the specific procedures to be utilized. Use of field analytical technology is encouraged, and should be chosen on a site-specific basis considering the constituents of concern and analytical equipment limitations. Use of field analytical equipment, type and frequency of confirmatory laboratory analysis should be approved or determined on a site-specific basis by the KDHE Project Manager. The appropriate BER SOP should be consulted for use of specific field analytical equipment, and the appropriate BER SOP for decontamination of equipment should also be consulted if equipment is to be re-used. If waste is generated during sampling activities, the BER SOP for investigative-derived waste (IDW) should be consulted. Common field analytical equipment includes a photoionization device (PID), flame ionization device (FID), explosimeter/combustible gas indicator/oxygen meter (CGI/O₂), litmus paper, pH meters, colorimetric tubes, immunoassay kits, and hazard categorization (HAZCAT) kits.

4. GENERAL CONSIDERATIONS

General container/hazardous material storage and disposal sampling considerations include:

- Drum, bung on one end - Withdraw sample through the bung opening.
- Drum, bung on side - Sample drums only if they are laying on side with bung up. Withdraw sample through the bung opening.
- Barrel, fiber drum, buckets, etc. - Withdraw samples through the top of barrels, fiber drums, buckets, and similar containers. Withdraw samples through fill openings of bags and sacks. Sampling should be conducted through exiting openings so as not to disturb containers further.
- Vacuum trucks, tanker cars/trailers, above-ground tanks - Withdraw sample through open hatch.
- Pond, pit, lagoon - Grid surface as appropriate based on size of lagoon. Surface, multi-phase layers and bottom should be considered for sampling.
- Waste pile - Take samples from several different points in and near the pile depending on the size of the pile.

- If multi-phase liquids are encountered, vertical profiling may be appropriate during sampling. Each phase should be sampled for the desired analyses.
- Air sampling may also be appropriate at or near containers or hazardous materials storage/disposal areas.

5. SPECIAL CONSIDERATIONS

Again, safety is primary concern in any hazardous materials operations, and the site-specific HSP should be closely adhered to during all site work. The Site Health and Safety Officer should be given authority to cease site operations if a personnel are not adhering to the HSP. Because site conditions, appropriate sampling methods and equipment, hazardous materials, containers, etc. are so variable, specific sampling methods, parameters, analytical equipment and needs, etc. should be determined on a site-specific basis and included in the SAP.

APPENDIX A

STANDARD OPERATING PROCEDURES BER-21

**LEVELS OF PROTECTION
FOR FIELD WORK**

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1. INTRODUCTION:

Personnel must wear protective equipment when response activities involve known or suspected atmospheric contamination, when vapors, gases, or particulates may be generated, or when direct contact with skin-affecting substances may occur. Respirators can protect lungs, gastrointestinal tract, and eyes against air toxicants. Chemical resistant clothing can protect the skin from contact with skin destructive and absorbable chemicals. Good personal hygiene can limit or prevent ingestion of material.

Equipment to protect the body against contact with known or anticipated chemical hazards has been divided into four categories according to the degree of protection afforded. All of the clothing or equipment listed for each layer of protection might not be worn all of the time. The specific equipment to be worn for each level will need to be determined by the site safety officer and project manager.

Level A: Should be worn when the highest level of respiratory, skin, and eye protection is needed. KDHE employees should not be exposed to Level A conditions. If unplanned Level A conditions are encountered in the field, KDHE employees will withdraw immediately and contact a qualified contractor to complete the task.

Level B: Should be selected when the highest level of respiratory protection is needed, but a lesser level of skin protection is required. Level B protection is the minimum level recommended on initial site entries until the hazards have been further defined by on-site studies and appropriate personnel protection utilized. KDHE employees should not be exposed to Level B conditions. If unplanned Level B conditions are encountered in the field, KDHE employees will withdraw immediately and contact a qualified contractor to complete the task.

Level C: Should be selected when the type(s) of airborne substance(s) is known, the concentration(s) is measured, and the criteria for using air-purifying respirators are met.

Level D: Should not be worn on any site with respiratory or skin hazards. Level D is primarily a work uniform providing minimal protection.

The Level of Protection selected should be based primarily on:

Type(s) and measured concentration(s) of the chemical substance(s) in the ambient atmosphere and its toxicity.

Potential or measured exposure to substances in air, splashes of liquids, or other direct

contact with material due to work being performed.

In situations where the type(s) of chemical(s), concentration(s), and possibilities of contact are not known, the appropriate Level of Protection must be selected based on professional experience and judgment until the hazards can be better characterized.

While personnel protective equipment reduces the potential for contact with harmful substances, ensuring the health and safety of response personnel requires, in addition, safe work practices, decontamination, site entry protocols, and other safety considerations. Together, these protocols establish a combined approach for reducing potential harm to workers.

2. LEVELS OF PROTECTION:

2.1. LEVEL A PROTECTION

2.1.1 Personnel Protective Equipment

Pressure-demand, self-contained breathing apparatus, approved by the Mine Safety and Health Administration (MSHA) and National Institute of Occupational Safety and Health (NIOSH).

Fully encapsulating chemical-resistant suit

Coveralls

Long cotton underwear

Gloves (outer), chemical-resistant

Gloves (inner), chemical-resistant

Boots, chemical-resistant, steel toe and shank. (Depending on suit construction, worn over or under suit)

Hard hat (under suit)

Disposable protective suit, gloves, and boots (Worn over fully encapsulating suit)

2-Way radio communications (intrinsically safe)

2.1.2 Criteria for Selection

Meeting any of these criteria warrants use of **Level A Protection**:

The chemical substance(s) has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on:

- measured (or potential for) high concentration(s) of atmospheric vapors, gases, or particulates
- or
- site operations and work functions involving high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates.

Extremely hazardous substances (for example: dioxin, cyanide compounds, concentrated pesticides, Department of Transportation Poison "A" materials, suspected carcinogens, and infectious substances) are known or suspected to be present, and skin contact is possible. The potential exists for contact with substances that destroy skin.

Operations must be conducted in confined, poorly ventilated areas until the absence of hazards requiring Level A protection is demonstrated.

Total atmospheric readings on the Century OVA System, HNU Photoionizer, and similar instruments indicate 500-1,000 ppm of unidentified substances.

2.2. LEVEL B PROTECTION:

2.2.1. Personal Protective Equipment

Pressure-demand, self-contained breathing apparatus (MSHA/NIOSH approved)

Chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; hooded, one or two-piece chemical-splash suit; disposable chemical-resistant coveralls)

Coveralls

Gloves (outer), chemical-resistant

Gloves (inner), chemical-resistant

Boots (outer), chemical-resistant, steel toe and shank

Boots (outer), chemical-resistant (disposable)

Hard hat (face shield)

2-way radio communications (intrinsically safe)

2.2.2. Criteria for selection

Meeting any one of these criteria warrants use of Level B protection:

The type(s) and atmospheric concentration(s) of toxic substances have been identified and require the highest level of respiratory protection, but a lower level of skin and eye protection. These would be atmospheres:

- with concentrations Immediately Dangerous to Life and Health (IDLH)
- exceeding limits of protection afforded by full-face, air-purifying mask
- containing substances for which air-purifying canisters do not exist or have low removal efficiency
- containing substances requiring air-supplied equipment, but substances and/or concentrations do not represent a serious skin hazard.
- the atmosphere contains less than 19.5% oxygen.
- site operations make it highly unlikely that the small, unprotected area of the head or neck will be contacted by splashes of extremely hazardous substances.
- total atmospheric concentrations of unidentified vapors or gases range from 5 ppm to 500 ppm on instruments such as the Century OVA System or HNU Photoionizer, and vapors are not suspected of containing high levels of chemicals toxic to skin.

2.3. LEVEL C PROTECTION:

2.3.1 Personal protective equipment

Full-face, air-purifying, canister-equipped respirator (MSHA/NIOSH approved)

Chemical-resistant clothing (coveralls; hooded, two-piece chemical splash suit; chemical-resistant hood and apron; disposable chemical-resistant coveralls)

Coveralls

Gloves (outer), chemical-resistant

Gloves (inner), chemical-resistant

Boots (outer), chemical-resistant, steel toe and shank

Boots (outer), chemical-resistant (disposable)

Hard Hat (face shield)

2-way radio communications (intrinsically safe)

2.3.2 Criteria for selection

Meeting all of these criteria permits use of Level C protection:

Measured air concentrations of identified substances will be reduced by the respirator to at or below the substance's exposure limit, and the concentration is within the service limit of the canister.

Atmospheric contaminant concentrations do not exceed IDLH levels.

Atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect the small area of skin left unprotected by chemical-resistant clothing.

Job functions have been determined not to require self-contained breathing apparatus.

Total vapor readings register between background and 5 ppm above background on instruments such as the HNU Photoionizer and Century OVA System.

Air will be monitored periodically.

2.4 LEVEL D PROTECTION:

2.4.1 Personal Protective Equipment

Coveralls

Gloves

Boots/shoes, leather or chemical-resistant, steel toe and shank - Boots (outer), chemical-resistant (disposable) - Safety glasses or chemical splash goggles*

Hard hat (face shield)

2.4.2 Criteria for selection

Meeting any of these criteria allows use of Level D protection:

No hazardous air pollutants have been measured.

Work functions preclude splashes, immersion, or potential for unexpected inhalation of any chemicals.

2.5 PROTECTIVE EQUIPMENT:

Respirators (half face or full face) - use full day, or if breakthrough occurs, or until situation no longer warrants respiratory protection. Respirators should be cleaned with soap and water after use.

Canisters - yellow for organic vapors
green for pesticides

Suits (listing from least protective to most)

(A.) Tyvek (uncoated) paper-like suit. Strictly for keeping clean. Properly dispose of after use.

(B.) Polyethylene coated tyvek - use while chemical sampling, i.e., solvents, pesticides, etc. Trash after dirty.

(C.) Saran covered tyvek - good overall suit. Better made. Use for chemical sampling.

(D.) Heavy duty yellow suit - all uses - clean with soap/water or steam and reuse. Use clorox on boots, suits, shoes, clothes to remove pesticides.

Gloves (listing from least protective to most)

Disposable surgical type gloves - strictly for keeping clean. Protection as outer cover for other gloves - disposable.

Light green rubber (latex/nitrile) with some chemical resistance. Use as outer glove. Offers minimal protection. Can be cleaned.

Long blue-green rubber (nitrile). Good chemical resistance. Clean and reuse.

Thick black, long (neoprene) - good for all uses. Clean and reuse.

Viton - long, thick, black (slick feel). good for all uses. Always use these for PCB and dioxin sampling. Wear layers; example: cotton then viton, then surgical.

Cotton liners - use under gloves when possible.

Visor/Hard Hat - Use during well or tank sampling where there is a danger of splashing or splattering.

Goggles & Safety Glasses - Use when eye protection is needed, or when using half face mask. Use common sense approach.

Boots - Rubber/Neoprene. Good for all uses. Use protective covers over boots.

2.6 DECONTAMINATION AND DISPOSAL:

In leaving a contaminated site, appropriate procedures must be carried out for decontamination and for safe packing of protective clothing, burial or safe packing of disposable gear, and transfer of equipment, gear, and samples from the "contaminated" area to the "clean" area. Sequences will depend upon several variables (e.g., SCBA inside or outside protective clothing) that must be worked out in advance. An optimal sequence is as follows:

- (1.) Remove boots;
- (2.) Remove exterior protective garment;
- (3.) Remove respirator;
- (4.) Remove disposable gloves;
- (5.) Remove interior coveralls and cooling vest (if used).

Protective clothing should be decontaminated with soap and water at the site, allowed to dry, folded or turned inside-out, placed in a plastic bag, sealed, and if necessary decontaminated further off-site. Face shields, goggles, respirators, rubber gloves (non-disposable), and rubber boots should also be washed between uses. If decontamination cannot be done at the site the protective clothing should be folded or turned inside-out, and taken back to the laboratory for decontamination. All disposable items should be sealed in plastic bags and disposed of according to the degree of contamination.

APPENDIX A

STANDARD OPERATING PROCEDURES BER-22

HALF/FULL-MASK RESPIRATOR

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1. INTRODUCTION

Half face (orinasal) and full-faced respirators using filter media cartridges or cannisters are industry labeled as air-purifying respirators or APRs. They are available in a wide variety of styles, colors and materials. **All** APRs must be approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health (MSHA/NIOSH). Prior to the use of an APR, the employee must be fit tested and have proper training in identifying when and what type of APR should be used under varying environmental conditions. Air-purifying respirators are not intended to serve as emergency escape masks.

2. CRITERIA FOR USE

2.1 PREREQUISITES FOR USE OF AN APR

The following prerequisites must be met before deciding on the use of an APR for respiratory protection:

- * Atmosphere must have an oxygen level above 19.5 %.
- * The contaminants and hazards must be identified.
- * The exposure concentration of the contaminant must be below NIOSH- REL (Recommended Exposure Limit) or other applicable exposure limit.

2.2 HALF FACE APR CRITERIA

- * In order to use a half face APR the **known** hazard should not present a danger to the unprotected facial areas, including the eyes.
- * The physical, chemical and toxicologic properties including odor threshold data of the contaminant(s) must be researched.
- * The contaminant can not be a mist or gas.
- * The warning properties of the contaminant(s) must be known (smell, taste, respiratory irritation etc.).
- * The NIOSH REL and OSHA PEL (Permissible Exposure Limit) must known for each contaminant.

Half face APRs are available to all field employees and should be taken to sites. If conditions exist that would cause an unacceptable risk to an employee using a half face APR, the employee should immediately leave the site and re-evaluate his/her options.

2.3 FULL FACE APR CRITERIA

- * The physical, chemical and toxicologic properties, including odor threshold limits must be researched before site work can commence.
- * The NIOSH recommended exposure limit (REL) or OSHA permissible exposure limit (PEL) must be known for each contaminant.
- * The warning properties must be known (smell, taste, respiratory or eye irritation).

* If there are unknown or unacceptable conditions at a site, the employee should leave the site and re-evaluate his/her options

3. TYPES OF AIR-PURIFYING DEVICES

3.1 PARTICULATE-REMOVING FILTERS

Particulates can occur as dusts, fumes, or mists. The particle size can range from macroscopic to microscopic, and their toxicological effects can be severe or innocuous. The hazard posed by a particulate can be determined by its TLV(Threshold Limit Value).A nuisance particulate will have a TLV of 10 mg/m³, while a toxic particulate may have a TLV well below 0.05 mg/m³.

Mechanical filters are classified according to the protection for which they are approved under schedule 21C of 30 CFR Part 11. Most particulate filters are approved only for dusts and/or mists with TLV's equal to or greater than 0.05 mg/m³. These dusts are usually considered to produce pneumoconiosis and fibrosis but are not toxic. Such filters have an efficiency of 80-90% for 0.6 millimeter (mm) particles.

Respirator filters approved for fumes are more efficient, removing 90-99% for 0.6 m particles. This type of filter is approved for dusts, fumes and mists with TLV's equal to or greater than 0.05 mg/m³.

Finally there is a high efficiency filter, which is 99.7% effective against particles 0.3 microns in diameter. It is approved for dusts, mists and fumes with a TLV less than 0.05 mg/m³.

Mechanical filters load up with particulates as they are used. As this occurs the filters become more efficient, but also more difficult to breath through. When a mechanical filter becomes difficult to breath through it should be replaced.

3.2 VAPOR OR GAS REMOVING CARTRIDGES

Absorbent filters are manufactured to remove a specific chemical or group of chemicals. In contrast, particulate-removing filters remove particulates regardless of their composition. Absorbents are available to remove specific organic vapors, acid gases, and ammonia, among others. Each absorbent filter has a maximum concentration use limit for that specific contaminant. Once an absorbent filter has been filled up with the contaminant, it will "breakthrough" that is, it will allow the full ambient concentration of the contaminant to enter the facepiece. Again, in contrast, particulate removing filters become more efficient (but harder to breath through) as they fill up. There is no breakthrough as with a gas or vapor.

Chemical absorbent filters also vary in their ability to remove contaminants. For example, vinyl chloride takes only 3.8 minutes to reach a 1% breakthrough -- that is, for 1% of the ambient concentration to enter the facepiece. In comparison, it takes 107 minutes for chlorobenzene to reach 1% breakthrough. Thus chlorobenzene is removed much more efficiently than vinyl chloride. Cartridge efficiencies should also be considered when selecting air-purifying respirators.

Some chemical absorbent cartridges and canisters have an expiration date. They may be used up to that date as long as they were not opened previously. If no expiration date is given on APR cartridges, they have an indefinite shelf life provided the protective covers are not opened. The date of manufacture can be obtained from the manufacturer. Once opened, they begin to absorb humidity and air contaminants whether or not they are in use, and their efficiency and service life decrease. A cartridge should be discarded after a maximum of 8 hours use.

3.3 LIMITS OF CARTRIDGES/CANISTERS

Cartridges or canisters used to filter breathing air do not remove the contaminant efficiently forever. Eventually, they will no longer filter or sort the contaminants. The higher the concentration the faster the cartridge is used up. To avoid quick wearing out and afford longer service, cartridges are assigned to maximum use concentration above which they should not be used.

4. DONNING AND FIT-TESTING

Every respirator wearer shall receive fitting instructions including demonstrations and practice in how the respirator should be worn, how to adjust it, and how to determine if it fits properly. Respirators shall not be worn when conditions prevent a good face seal. Such conditions may be a growth of beard, sideburns, a skull cap that projects under the facepiece, or temple pieces on glasses. Also, the absence of one or both dentures can seriously affect the fit of a facepiece. The worker's diligence in observing these factors shall be evaluated by periodic check. To assure proper protection, the facepiece fit shall be checked by the wearer each time he puts on the respirator. They may be done by fitting instructions.

4.1 FITTING

Once the respirator is on, two pressure(a negative and positive) tests should be conducted to assure proper fit.

4.1.1 NEGATIVE PRESSURE TEST

Close off cartridge inlet with the palm of the hand, gently inhale so the facepiece collapses against the face for about 10 seconds. Hold the vacuum against the respirator. If the vacuum is not maintained for 10 seconds, the faceplate is leaking.

4.1.2 POSITIVE PRESSURE TEST

Close off exhalation valve with the palm of the hand (valve cover may need to be removed). Gently exhale into the facepiece so a slight positive pressure builds and note if positive pressure can be built. If it cannot, air is leaking out.

5. MAINTENANCE (Care and Cleaning of Respirators)

5.1 GENERAL REQUIREMENTS

Staff using respirators on a routine basis should have a program for their care and cleaning. The purpose of a program is to assure that all respirators are maintained at their original effectiveness. If they are modified in any way, their Protection Factors may be voided. This program should be based on the number and types of respirators, working conditions, and hazards involved. In general, the program should include:

- Inspection (including a leak check)
- Cleaning and disinfection
- Repair
- Storage

5.2 INSPECTION

Inspect respirators after each use. Inspect a respirator that is kept ready for emergency use weekly to assure it will perform satisfactorily.

On air-purifying respirators, thoroughly check all connections for the presence and condition of gaskets and "O" rings and for proper tightness. Check the condition of the facepiece and all its parts, connecting air tube, and headbands. Inspect rubber or elastomer parts for pliability and signs of deterioration.

Maintain a record for each respirator inspection, including date, inspector, and any unusual conditions or findings.

5.3 CLEANING AND DISINFECTING

Staff required to wear respirators should clean and disinfect respirators as follows:

- * remove all cartridges, canisters, and filter, plus gaskets or seals not affixed to their seats;
- * remove elastic headbands;
- * remove exhalation cover;
- * remove speaking diaphragm or speaking diaphragm - exhalation valve assembly;
- * remove inhalation valves;
- * wash facepiece and breathing tube in cleaner/sanitizer powder mixed with warm water, preferably at 120° to 140°. Wash components separately from the facemask, as necessary. Remove heavy soil from surfaces with a hand brush;

- * remove all parts from the wash water and rinse twice in clean warm water;
- * air dry parts in a designated clean areas;
- * wipe facepieces, valves, and seats with a damp lint-free cloth to remove any remaining soap or other foreign materials.

RESCINDED

APPENDIX A

STANDARD OPERATING PROCEDURES BER-23

SELF-CONTAINED BREATHING APPARATUS

APPENDIX A

STANDARD OPERATING PROCEDURE BER - 24

CONDUCTING ON-SITE REVIEWS OF FIELD SAMPLING ACTIVITIES

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ATTACHMENT A On-site Review/ Field Audit Checklist

1. PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish a consistent process for planning, conducting and reporting on-site reviews for field sampling methods and site specific safety plans executed in support of Bureau of Environment Remediation (BER) programs as required by the BER Quality Management Plan (QMP). Additionally, the review is intended to identify strengths as well as weaknesses in the collection of environmental data and site safety.

2. APPLICATION

The policies and procedures outlined in this SOP are applicable to all Bureau of Environmental Remediation projects where BER personnel or consultants are engaged in the collection or activities related to the collection of environmental samples for analysis.

3. GENERAL OVERVIEW

An on-site field review should be conducted without the prior knowledge of the field team being reviewed. In preparation, the person(s) who will be conducting the review should become familiar with the overall organization and objective of the field activity by examining background documents including the site specific Quality Assurance Project Plan (QAPP), sample\work plan and the health and safety plan. If examination of background materials before the audit will alert the field team to the audit then the documents should be inspected on site. In this situation the audit will more closely examine actual sampling and safety procedures and less on the QAPP/sampling plan content.

4. REVIEW PROCESS

The person conducting the audit should ideally arrive at the location of the field activity unannounced. The implementation of the review should begin with contacting the on-site manager and communicating the procedures that will be followed while conducting the on-site review. The review should be conducted with as little disruption to the ongoing field activity as is possible. The reviewer should evaluate and document the implementation of the procedures outlined in the project QAPP, work/sample plan and bureau approved SOPs. The evaluation will include sample collection, labeling, sample preservation, equipment calibration, decontamination and chain of custody procedures. The evaluation should also examine whether the site specific health and safety plan is being followed. Procedural concerns that the reviewer feels could jeopardize sample integrity should be brought to the attention of the on-site manager. The guideline for the evaluation is the field review checklist (attached). The degree to which this checklist is completed is dependant on the type of investigation or field activity that is taking place. The person performing the review will need to evaluate the activity by observing project procedures, interviewing team members and checking log books for proper documentation.

5. REVIEW COMPLETION AND DISCUSSION

Upon completion of the review, the “Recommendations” and “Follow Up Actions” sections of the guide list should be completed by the reviewer. In the event that serious violations were observed, a meeting should be held with the on-site manager and project manager to discuss the infractions. Otherwise, upon completion, the audit form is circulated to the project manager and section chief for review and signature.

ATTACHMENT A
(On-Site Review / Field Audit Checklist)



ON-SITE REVIEW/ FIELD AUDIT CHECKLIST

Bureau of Environmental Remediation/Remedial Section

DATE OF AUDIT: ____ / ____ / ____

PERSON PERFORMING AUDIT: _____

TITLE

Site Name: _____

Site Location: _____

Project Manager: _____ Representing (*circle one*): State Contractor

Project Type (*circle one*):

Assessment Investigation Remediation Verification Split Sampling Special Project

Program Type (*circle one*):

SCP Pre-Remedial VCPRP SWP Brownfields Other: _____

On-Site Personnel and Their Responsibility: _____

QAPP GENERAL:

Yes *No*

Has the auditor read site specific documents ? (QAPP, safety plan , etc.)

☐ ☐

Is a copy of the work plan/sampling plan/ QAPP on-site and readily available?

☐ ☐

Are all team members familiar with the sampling objectives?

☐ ☐

Is property access documentation available on site?

☐ ☐

If not, explain: _____

Is a field log book maintained on-site by the Project Manager?

☐ ☐

List any monitoring equipment used on-site? _____

When was the monitoring equipment last calibrated and what is the calibration frequency?

Is the monitoring equipment calibration documented?

Yes *No*
☐ ☐

Where? _____

GENERAL SAMPLING PROCEDURES:

Is the sampling activity following the sampling plan \ QAPP ?

Yes

No

☐☐

If not, explain why:_____

Does the sampling equipment appear that it was cleaned prior to sampling?

☐☐

Is nonexpendable sampling equipment decontaminated between samples?

☐☐

Explain the decontamination process:_____

Where is decontamination water disposed of?_____

Are disposable gloves worn during sampling ?

☐☐

Were gloves changed between samples?

☐☐

Do sample labels contain; project name, date, sample time, sample #, and sample depth?

☐☐

If no, what information is missing ?_____

Were samples placed on ice immediately after collection?

☐☐

If samples other than VOCs were collected were they preserved properly ?

☐☐

If NO, explain:_____

Were photos taken to document sampling and the physical attributes of the site?

☐☐

Was a photo log kept in the field logbook?

☐☐

Were trip blanks utilized ?

☐☐

Describe type and number of trip blanks:_____

Describe if any other QA/QC samples collected:_____

Were split samples collected ?

☐☐

Describe split sample collection procedures:_____

Are samples logged/documentated as they are taken ?

☐☐

Where ?_____

	<u>Yes</u>	<u>No</u>
If field screening is being used are confirmation samples being collected for laboratory analysis?	<input type="checkbox"/>	<input type="checkbox"/>
At what percentage, and which laboratory? _____		

Is chain-of-custody being maintained?	<input type="checkbox"/>	<input type="checkbox"/>
If no, describe: _____		

SAFETY:

	<u>Yes</u>	<u>No</u>
Is an approved Site Specific Safety Plan on-site and readily available?	<input type="checkbox"/>	<input type="checkbox"/>
Is utility clearance documentation available ?	<input type="checkbox"/>	<input type="checkbox"/>
Have all team members signed the Site Specific Safety Plan?	<input type="checkbox"/>	<input type="checkbox"/>
Do all team members know directions, to the referenced hospital, from the site?	<input type="checkbox"/>	<input type="checkbox"/>
Are there any site conditions that warrant a concern for safety? (rubble, debris, weather, etc.).	<input type="checkbox"/>	<input type="checkbox"/>
Explain: _____		

Is hearing protection worn during Geoprobe hammer operation ?	<input type="checkbox"/>	<input type="checkbox"/>
Is protective footwear worn around Geoprobe \ drill rig ?	<input type="checkbox"/>	<input type="checkbox"/>
Were hard hats worn during drilling operations ?	<input type="checkbox"/>	<input type="checkbox"/>
Is site waste including disposable sampling equipment bagged and properly disposed of ?	<input type="checkbox"/>	<input type="checkbox"/>

SOIL SAMPLING:

Were background samples collected ?	<u>Yes</u> <input type="checkbox"/>	<u>No</u> <input type="checkbox"/>
If no, explain: _____		

What procedures and equipment were used to collect the soil samples? _____

How were soil VOC samples collected ? _____

WELL SAMPLING:

Type of well(s) sampled: _____

Were wells purged according to the SOP or statement of work document ?	<u>Yes</u> <input type="checkbox"/>	<u>No</u> <input type="checkbox"/>
Explain the purging procedure: _____		

Was depth of wells and depth to water measured before purging ?	<input type="checkbox"/>	<input type="checkbox"/>
---	--------------------------	--------------------------

	<u>Yes</u>	<u>No</u>
Was depth to water measured from a known reference point?	<input type="checkbox"/>	<input type="checkbox"/>
What was the known reference point: _____		
How was purged water disposed of? _____		
Was the measuring device decontaminated between wells ?	<input type="checkbox"/>	<input type="checkbox"/>
How were samples collected ? (i.e. bailer, pump, check valve, etc.) : _____		
Was a new bailer / rope or tubing used for each well ?	<input type="checkbox"/>	<input type="checkbox"/>
Were VOC vials preserved with acid?	<input type="checkbox"/>	<input type="checkbox"/>
If no, why: _____		

Field Audit Findings:

Recommendations:

Follow Up Actions:

[illegible]

Date _____

Date

Date _____

[illegible]

APPENDIX A

STANDARD OPERATING PROCEDURES BER-25

MOBILE LABORATORY

BUREAU OF ENVIRONMENTAL REMEDIATION

STANDARD OPERATING PROCEDURE BER-25

MOBILE LABORATORY

Revisor: Farrell Dallen Date of Revision: July 18, 2000

Remedial Section Chief: _____ Date: _____

Tank Section Chief: _____ Date: _____

ARS Section Chief: _____ Date: _____

Bureau QA Representative: _____ Date: _____

Bureau Manager: _____ Date: _____

Revisor: Farrell Dallen Date of Revision: January 11, 2007

Remedial Section Chief: _____ Date: _____

Tank Section Chief: _____ Date: _____

ARS Section Chief: _____ Date: _____

Bureau QA Representative: _____ Date: _____

Bureau Manager: _____ Date: _____

Revisor: _____ Date of Revision: _____

Remedial Section Chief: _____ Date: _____

Tank Section Chief: _____ Date: _____

ARS Section Chief: _____ Date: _____

Bureau QA Representative: _____ Date: _____

Bureau Manager: _____ Date: _____

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1 INTRODUCTION

The purpose of this standard operating procedure (SOP) is to describe minimum operating requirements and recommended techniques for the operation of a Gas Chromatograph (GC) installed in a mobile laboratory. The operator of the mobile laboratory equipment should be thoroughly familiar with the operation and limitations of the equipment, and with the goals and limitations of field chemistry. These SOPs presuppose that the analyst has a basic familiarity with the equipment and with analytical techniques.

2 MOBILE LABORATORY OPERATIONS

The mobile laboratory consists of a GC equipped with two detectors and a personal computer with data handling software that has the capability to control and collect data from two GCs. This equipment is capable of identifying and quantifying low levels of a number of volatile organic compounds (VOCs) in the field as the samples are taken.

2.1 SAFETY CONSIDERATIONS

The analyst must be aware of the particular hazards associated with the pressurized gases used with the GC and the various toxic chemicals used or encountered in the analytical work. These hazards may be multiplied many times by the fact that the laboratory is enclosed in a vehicle. They are listed and discussed below:

2.1.1 Pressurized gas cylinders

Each of the cylinders may contain as much as 2000 to 3000 psi of pressure when it is installed. This pressure may be released explosively if the cylinder valve is damaged or broken. For this reason, no cylinders will be transported in the van without being properly restrained in the brackets provided. In addition, any cylinder which is not in use should have the valve covered with the screw-on cap that is provided with the cylinder.

2.1.2 Gas leaks

The mobile laboratory GC uses highly purified nitrogen. The GC that presently is in storage and was formerly used in the soil gas van uses three types of pressurized gases: compressed air, nitrogen, and hydrogen. All of these gases are colorless and odorless, so the operator must be alert to detect and prevent leaks.

Compressed air is harmless to persons, except for the possibility of a damaged bottle or valve as mentioned above. It may also support or accelerate combustion in the event of a fire. Nitrogen gas may asphyxiate if it is present at high concentrations in a confined space. That

is, it may exclude ambient air enough to cause an oxygen deficiency to persons inside the van.

Hydrogen gas is highly explosive. If allowed to accumulate at even moderate concentrations it could be a serious fire or explosion hazard.

For these reasons, all operators of the equipment must exercise due caution in handling the pressurized cylinders, and monitor for gas leaks on a regular basis. Gas leaks may be indicated by unusually rapid loss of gas from a cylinder, low pressure or flow in the GC system, by any indications of damage to the regulators or gas tubing due to shock or impact, or by hissing noises. The analyst should also perform leak checks on all fittings at least each time any section of the system is disconnected, and monitor operation of the GC for indications of leaks.

2.1.3 Other hazardous materials

Most of the chemical standards used in the fieldwork will contain hazardous organic chemicals which may also be flammable or explosive. Care should be taken to avoid undue exposure to fumes or splash contact with these chemicals. Generally, the standards will be contained in airtight bottles, bulbs, or pressure tanks. The operators should use care in handling these containers to avoid spills, leaks, or breakage, which cause personnel hazards or lab contamination.

2.1.4 Other workplace hazards

The field personnel will be required to handle hot, breakable, sharp, or otherwise dangerous materials regularly. Care should be taken with handling and storage of these materials to avoid undue breakage, damage, and injuries. On rare occasions, it may be necessary for the field personnel to use personnel protective devices such as respirators, protective clothing, or monitoring devices. Specialized training is required of all field personnel working at contamination sites, and persons who have not completed the training will not be permitted on those sites.

2.2 PRELIMINARY CONSIDERATIONS AND EQUIPMENT STARTUP

The type of site to be investigated and the contaminants of interest will determine the choice of detectors and operating methods that the analyst will use. Prior to embarking on fieldwork, the analyst and the site manager should discuss the nature of the investigation to determine how many samples will be required, the type of analyses required, and the detection levels required.

The analyst should begin planning for fieldwork at least one working day ahead of the expected departure, in order to obtain any needed supplies and equipment, to warm up the GC detectors and to analyze standards to check the performance of the GC. Generally, the Electron Capture Detector (ECD) will be required whenever chlorinated hydrocarbons are targeted, and the Photo Ionization Detector (PID) will be used for most petroleum contamination sites. The ECD may

require several hours to become stable following startup, therefore it may be necessary to start the GC the day prior to leaving for fieldwork.

The compressed gases used with the GC are specialized laboratory-grade supplies and are not generally available in the field or on short notice, therefore the analyst must be aware of the amount of compressed gas in the mobile laboratory to assure an adequate supply for a project.

The analyst should prepare and use a startup checklist that includes such activities as:

- (1) Inventory supplies and equipment prior to fieldwork. Decontaminate equipment if necessary. Do not depend on equipment being clean if it has not been used recently.
- (2) Start generators and check power supply. An extension cord may be connected to an external power source for overnight maintenance or warmup.
- (3) Replace injection port septum at least weekly.
- (4) Note the pressure remaining in the pressurized gas cylinders. Check the gas flow regulators for correct pressure settings. Nitrogen should flow through the column at all times. The flow may be reduced between field work events to conserve nitrogen.
- (5) Select GC temperature program and method to be used on the project. Turn on the laboratory equipment to warm up and stabilize prior to going to the field.

Note: Approximate warmup times--

FID	30 to 60 minutes
PID	2 to 4 hours
ECD	4 to 8 hours

- (6) Establish a stable baseline on the GC. If GC has not been used for several days, the column may need conditioning by running the temperature program and allowing the column temperature to remain at 140EC for 1-2 hours. Analyze the standard and compare response times and response factors with previous GC operations. Update the identification tables if necessary.
- (7) Prepare working standards by diluting the appropriate intermediate standard, which is prepared in methanol, with glass distilled water for soil and water samples. For soil gas samples the working standard is prepared by injecting the appropriate amount of standard into a gas bulb and letting the bulb equilibrate.
- (8) Check for safe and efficient stowage of equipment and documentation materials before the vehicle is moved.

Note--Many of these items can be performed while the vehicle is en route to the site, and the order may be varied depending on circumstances.

2.3 STANDARD AND SAMPLE PREP FOR HEADSPACE FIELD ANALYSIS

2.3.1 Heating Block

The heating block is turned on and allowed to equilibrate at 75EC prior to heating any standards or samples in the heating block. When any other temperatures are used, a note to that fact is made on the GC Field Sample List.

2.3.2 Standards

Stock standards are purchased containing the analyte of interest dissolved in methanol. From the stock standards, intermediate standards are made by diluting the appropriate amount of stock standard with methanol. The stock and intermediate standards are kept in a freezer.

Working standards that are used for water and soil samples are prepared weekly in glass distilled water in the Division of Health and Environment Laboratory (DHEL) from intermediate standards prior to going to the field. The working standards are transferred to 40 milliliter (ml) VOC vials and are refrigerated or kept on ice in a cooler until used. A 5.0 ml portion of the working standard is pipetted into a 10 ml headspace vial. The vial is immediately sealed with a Teflon lined seal, labeled, and placed in the heating block for at least 30 minutes prior to analysis. More than one headspace vials may be prepared with the standard to analyze throughout the work week. If a standard is kept in the heating block greater than 24 hours, the standard can be used to check the retention time of the analytes.

Working standards that are used for soil gas samples are prepared weekly either as described above from aqueous standards or standards prepared in a gas sampling bulb. The bulbs are cleaned prior to being used. The bulb is evacuated by removing the septum, opening the valves, and blowing clean air through the bulb. The bulb is then placed in an oven at 105EC. When the gas sample bulb is removed from the oven, a new septum will be installed and the valves closed while the bulb is still hot. When the bulb cools, a slight vacuum will be formed. An appropriate amount of an intermediate standard will be injected through the septum, using an gas tight syringe. Following this injection, one of the valves will be opened to admit enough air to equilibrate the pressure in the bulb to atmospheric pressure and immediately closed. The bulb will be checked for any visible condensate on the inside. If no condensate is present, the standard is ready for use.

When analyzing soil gas samples, the GC may be calibrated using standards that have been prepared either in

Records are kept of all standards prepared. These records should include the initial concentration of the standard, the dilution factor, and the media used to dilute the standard.

2.3.3 Water Samples

A 5.0 ml portion of the sample is pipetted into a 10 ml head space vial with as little agitation as possible. The vial is immediately sealed with a Teflon lined seal, labeled, and placed in the heating block for at least 30 minutes prior to analysis.

2.3.4 Soil Samples

With an electronic balance approximately 1 gram of the soil is weighed directly into a 10 ml head space vial as quickly and as representatively as possible. The top layer of the soil in the sample container which is exposed to air is discarded and a core is made through the sample to be analyzed. As quickly as possible after the sample is weighed, 5.0 ml glass distilled water is pipetted on top of the soil in the head space vial. The vial is immediately sealed with a Teflon lined seal, labeled, and placed in the heating block at least 60 minutes prior to analysis.

2.3.5 Soil Gas Samples

A soil gas sample is collected in a gas-tight syringe with a three-way stopcock, utilizing direct push technology according to KDHE SOP BER-07. A glass gas-tight syringe is used to obtain a sample through the three-way stopcock and injected it into the GC. The appropriate detector(s) is use for the analyte of concern.

3 QUALITY CONTROL

Quality control is the use of cross checks and redundant testing of samples, standards, and blanks to detect any random or systematic errors that reduce the accuracy or reliability of the overall investigation. The main elements of the quality control program for field screening procedures are described below.

3.1 USE OF STANDARDS

Standards must be run each day prior to performing any analyses. When a standard is analyzed, the response time and determined value should be compared with the known value of the standard. If these values are not within 20%, the raw data must be corrected prior to reporting, or the method should be changed to reflect determined values of the standard to be within 20% of the known value. A significant change in these constants may indicate some problem with

the system. If no problem is discovered after due investigation, the analyst may update the method to reflect the change.

A standard should be run after every 10 samples or 4 hours, whichever comes first. A standard should also be run at the end of each project or each day of fieldwork. The response time and response factor of each standard should be compared with the identification table. Errors and discrepancies in excess of 25% in response factor or 5% in response time should be noted in the log book, and the instrumentation should be inspected for leaks or other possible problems.

3.2 USE OF BLANKS

Blanks are the injection of samples which are known not to or expected not to contain the analyte of interest. They are to be used regularly to authenticate the sample handling and decontamination procedures that are used for equipment. Water blanks should be used any time a particular water is used to perform headspace analyses on soils. Air blanks should be performed routinely on syringes after highly contaminated samples are analyzed to check for carryover in the syringe.

3.3 DUPLICATE SAMPLES

Duplicate samples will be analyzed for at least 20% of the water and soil samples that are collected with a minimum of one per day. The project manager will decide how many samples should be submitted to a certified laboratory to verify the field analysis.

3.4 DOCUMENTATION

The analyst will also prepare and use appropriate sample log sheets for each project, containing at least the following information:

Analyst, project name, project location, date, detectors used, sample number, time analyzed, type of sample (soil gas, soil, water), concentration of each standard used, and comments.

Hard copies of each chromatograph for all samples and standards will be printed and stored with the sample log sheet.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-26

YSI MODEL 63 WATER QUALITY ANALYZER

BUREAU OF ENVIRONMENTAL REMEDIATION

STANDARD OPERATING PROCEDURE BER-26

YSI MODEL 63 WATER QUALITY ANALYZER

Revisor: Travis Kogl Date of Revision: _____

Remedial Section Chief: _____ Date: _____

Tank Section Chief: _____ Date: _____

ARS Section Chief: _____ Date: _____

Bureau QA Representative: _____ Date: _____

Bureau Manager: _____ Date: _____

Revisor: _____ Date of Revision: _____

Remedial Section Chief: _____ Date: _____

Tank Section Chief: _____ Date: _____

ARS Section Chief: _____ Date: _____

Bureau QA Representative: _____ Date: _____

Bureau Manager: _____ Date: _____

Revisor: _____ Date of Revision: _____

Remedial Section Chief: _____ Date: _____

Tank Section Chief: _____ Date: _____

ARS Section Chief: _____ Date: _____

Bureau QA Representative: _____ Date: _____

Bureau Manager: _____ Date: _____

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1. INTRODUCTION

The YSI Model 63 is a handheld pH, conductivity, salinity, temperature, micro-processor based digital meter with an attached pH, conductivity, and temperature probe.

2. PH CALIBRATION

The YSI Model 63 must be calibrated before making pH measurements. Calibration may be performed at 1, 2 or 3-point (at pH 7, 4, and 10 or at pH 6.86, 4.01, and 9.18). Perform a 1-point calibration **ONLY** if a previous 2 or 3-point calibration has been performed recently. In most cases a 2-point calibration will be sufficient for accurate pH measurements. If the general range of pH is not known, a 3-point calibration may be necessary.

The operator may choose from two sets of buffer values. The first set is the standard YSI pH buffer solution with pH values of 7, 4, and 10. The second set is the NIST buffer solutions with pH values of 6.86, 4.01 and 9.18. Calibration solutions, methods and readings should be recorded in the field log book. Calibrate as closely as possible to sample temperature.

2.1 PROCEDURE

- (1) Turn the instrument on by pressing the ON/OFF key. Press the MODE key until pH is displayed.
- (2) Rinse the probe with deionized or distilled water, then rinse it with some of the pH solution to be used for calibration.
- (3) Place 30 to 35 ml of the pH solution in the 100 mL graduated cylinder. Immerse the probe into the graduated cylinder. Be sure the buffer covers the side of the black thermistor located on the side of the gray probe bulkhead.
- (4) Press the ▼▲ keys simultaneously to enter the calibration menu (if using pH 4.01, 6.86, press ▼▲ keys a second time).
- (5) Press ENTER. The pH value of the buffer solution will be displayed. When the decimal point stops flashing, press ENTER again.
- (6) If calibrating to more points, place the probe in the second buffer (after rinsing and drying).
- (7) Press ENTER. The pH of the solution will be displayed and a decimal point will flash. When the decimal point stops flashing, press and hold the ENTER key until the display reads SAVE.

- (8) Repeat steps 4-6 for a third buffer solution.
- (9) At the end of calibration, press MODE and rinse the sensor to begin pH measurements.

3. CONDUCTIVITY CALIBRATION

System calibration is rarely required because of the factory calibration of the YSI Model 63. However, from time to time it is wise to check the system calibration and make adjustments when necessary.

Prior to calibration of the YSI Model 63, it is important to remember the following:

- Always use clean, properly stored, NIST traceable calibration solutions (see *12 Accessories and Replacement Parts*). When filling a calibration container prior to performing the calibration procedures, make certain that the level of calibrant buffers is high enough in the container to cover the entire probe. Gently agitate the probe to remove any bubbles in the conductivity cell.
- Rinse the probe with distilled water (and wipe dry) between changes of calibration solutions.
- During calibration, allow the probe time to stabilize with regard to temperature (approximately 60 seconds) before proceeding with the calibration process. The readings after calibration are only as good as the calibration itself.
- Perform conductivity calibration at a temperature as close to 25°C as possible. This will minimize any temperature compensation error.

3.1 PROCEDURE

Follow these steps to perform an accurate calibration of the YSI Model 63:

- (1) Turn the instrument on and allow it to complete its self test procedure.
- (2) Select a calibration solution which is most similar to the sample you will be measuring.
 - For sea water choose a 50 mS/cm conductivity standard (YSI Catalog# 3169)
 - For fresh water choose a 1 mS/cm conductivity standard (YSI CaWog# 3167)
 - For brackish water choose a 10 mS/cm conductivity standard (YSI Catalog # 3168)

- (3) Place at least 7 inches of solution in the plastic container (provided with the Model 63) or a clean glass beaker.

NOTE: Do NOT use the 100 mL graduated cylinder. The diameter of the cylinder is too small for accurate conductivity measurements.

- (4) Use the **MODE** key to advance the instrument to display conductivity.
- (5) Insert the probe into the solution deep enough to completely cover the probe. Both conductivity ports must be submerged.
- (6) Allow at least 60 seconds for the temperature reading to become stable.
- (7) Move the probe vigorously from side to side to dislodge any air bubbles from the electrodes.
- (8) Press and Release the **▲▼** keys simultaneously. The **CAL** key will appear at the bottom left of the display to indicate that the instrument is in calibration mode.
- (9) Use the **▼▲** keys to adjust the reading on the display until it matches the value of the calibration solution that you are using.
- (10) Once the display reads the exact value of the calibration solution being used, press the **ENTER** key. The word **SAVE** will flash across the display for a second, indicating that the calibration has been accepted.

4. MAKING MEASUREMENTS

After the system has been set-up and the pH calibrated, the instrument is ready to make measurements. To make measurements, insert the probe into the sample, shake gently to remove any trapped bubbles and wait for the readings to stabilize (approximately 60 seconds). The first reading after storage in a buffer solution may take longer to stabilize (5 to 10 minutes), therefore the probe should be stored in the transport chamber when making field measurements. The probe must be inserted into the sample far enough to cover the pH, temperature and conductivity sensors.

The Model 63 has six modes:

pH - Displays pH and temperature in °C.

Conductivity - a measurement of the conductive material in the liquid sample without regard to temperature. Also displays the temperature in °C.

Specific Conductivity - Also known as temperature compensated conductivity which automatically adjusts the reading to the calculated value that would have been read if the sample were 25° C.

Salinity - A calculation done by the instrument electronics, based upon the conductivity and temperature readings. Also displays temperature in °C.

Recall - Allows previously stored data to be displayed.

Erase all - Allows all previously stored data to be erased.

To determine the mode that the instrument is displaying, observe the small legend on the far right side of the LCD. If the instrument is reading pH, the large numbers on the display will be followed by a **pH**.

If the instrument is reading conductivity, the large numbers on the display will be followed by either a **μS** or **mS**. Additionally, the small portion of the display will show the °C and it will not be flashing.

If the instrument is reading Specific Conductance, the large numbers in the display will be followed by either a **μS** or **mS**. Additionally, the display will show the °C flashing on and off.

If the instrument is reading salinity, the large numbers on the display will be followed by a **ppt**.

4.1 AUTO RANGING AND RANGE SEARCHING

The YSI Model 63 is an autoranging instrument. When the probe is initially introduced into a sample or calibration solution, the instrument will go into a range search mode that may take as long as 5 seconds. During some range searches the instrument will display rANG to indicate its movement from one range to another. The length of the range search depends on the number of ranges that must be searched in order to find the correct range for the sample.

4.2 SAVING DATA

The Model 63 is capable of storing up to 50 different sets of readings. Each set consists of pH, conductivity, specific conductance, salinity, and temperature. The instrument will also assign a site identification number to each set of readings. While pH, conductivity, specific conductance, or salinity is displayed on the screen, press the ENTER key and hold it down for 2 seconds. The screen will flash SAVE. On the display along with the current site

identity (1 through 50). When all 50 sites are full, the display will flash FULL. This message will remain on the screen until a key is pushed (even after power down).

4.3 RECALLING DATA

To recall data, press the MODE key until **rcI** is displayed on the screen, along with the site ID number in the lower right corner. Press the ENTER key to display the last set of data that was saved. The pH and temperature will be displayed. Press the ENTER key again to display conductivity and temperature. Press the ENTER key again to display specific conductance and salinity. All readings are displayed with the temperature.

Press the ▲ and ▼ keys to move up and down the saved data sets. When the desired Site ID number is displayed, press the ENTER key to display the data. Press the MODE key two more times to return to normal operation.

4.4 ERASING DATA

To erase the data that is stored in the Model 63's memory, press the **MODE** key until the Model 63 displays **ErAS** on the screen. Press and hold the **DOWN ARROW** and **ENTER** keys simultaneously for approximately 5 seconds. Successful erasure is indicated by the Model 63 displaying **DONE** on the display for 1 to 2 seconds. The instrument will automatically change to pH mode after completion and the next saved data will be stored in site ID# 1.

IMPORTANT: Data in all 50 site ID's will be erased completely and will be lost forever. Do not use the erase function until all recorded data has been transcribed to an archive outside the Model 63.

4.5 ERROR MESSAGES

Refer to the manufacturer's operation manual for error messages.

4.6 MAINTENANCE

4.6.1 pH Sensor Precautions

- (1) When making measurements or performing the calibration procedure, make certain that the level of sample or pH buffer is high enough to cover both the pH and temperature sensors.
- (2) Rinse the probe with deionized water between changes of calibration buffer solutions.

- (3) During pH calibration, allow the sensors time to stabilize with regard to temperature (approximately 60 seconds) before proceeding with the calibration protocol. The pH readings after calibration are only as good as the calibration itself.
- (4) Clean and store the probe according to the instructions in 4.6.2.

4.6.2 pH Sensor Cleaning

Cleaning is required whenever deposits or contaminants appear on the glass pH sensor. Unscrew and remove the small guard that protects the pH sensor. Use tap water and a clean cloth or lens cleaning tissue to remove all foreign material from the glass sensor.

If good pH response is not restored by the above procedure, perform the following additional procedure:

- (1) Soak the probe for 10 to 15 minutes in clean water containing a few drops of commercial dishwashing liquid.
- (2) GENTLY clean the glass bulb by rubbing with a cotton swab soaked in the cleaning solution.
- (3) Rinse the probe in clean water, wipe with a cotton swab saturated with clean water, and then rerinse with clean water.

If good pH response is still not restored by the above procedure, perform the following additional procedure:

- (1) Soak the pH sensor for 5 minutes in one molar (1 M) hydrochloric acid (HCl).
- (2) GENTLY clean the glass bulb by rubbing with a cotton swab soaked in the acid.
- (3) Rinse the probe in clean water, wipe with a cotton swab saturated with clean water, and then rerinse with clean water.
- (4) Reinstall the small guard that protects the pH sensor.

If biological contamination of the reference junction is suspected or if good response is not restored by the above procedures, perform the following additional cleaning step:

- (1) Soak the probe for approximately 1 hour in a 1 to 1 dilution of commercially-available chlorine bleach.

- (2) Rinse the probe with clean water and then soak for 1 hour in clean water to remove residual bleach from the junction.

4.6.3 pH Sensor Storage

For short term storage between measurements in the field (up to one week), place the probe in the transport chamber in the side of the instrument case. Make sure that the sponge inside the chamber is wet (tap water). For long term storage (over one week), place the probe in the storage bottle (provided) containing a mixture of 50% pH 4 buffer and 50% 1.5M KCl. This will assure the fastest possible pH response. If this mixture is not available, storage in tap water is the next best choice.

Do NOT store the probe dry or in distilled or deionized water.

NOTE: After storage in the pH 4/KCl solution described above, place the probe in the transport chamber in the side of the instrument case or soak the probe in pH 7 buffer for 5 to 10 minutes allowing it to acclimate before calibrating. If the probe has been inadvertently left in air and the reference electrode junction has dried out, good function can usually be restored by soaking the probe in the pH 4/KCl solution described above.

4.6.4 Conductivity Sensor Cleaning

The single most important requirement for accurate and reproducible results in conductivity measurement is a clean cell. A dirty cell will change the conductivity of a solution by contaminating it.

NOTE: Always rinse the conductivity cell with clean water after each use.

To clean the conductivity cell:

- (1) Dip the cell in cleaning solution and agitate for two to three minutes. Any one of the foaming acid tile cleaners, such as Dow Chemical Bathroom Cleaner, will clean the cell adequately. When a stronger cleaning preparation is required, use a solution of 1:1 isopropyl alcohol and one molar (1 M) hydrochloric acid (HCl). Remove the cell from the cleaning solution.
- (2) Use the nylon brush (supplied) to dislodge any contaminants from inside the electrode chamber.
- (3) Repeat steps one and two until the cell is completely clean. Rinse the cell thoroughly in deionized, or clean tap water.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-27

OPERATION OF NITON X-RAY FLUORESCENCE (XRF) ANALYZER

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1. INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to establish a basic process for use of the KDHE Niton Model 733 X-ray Fluorescence (XRF) Analyzer.

All use of the Niton XRF must be approved by and under the supervision of the KDHE/BER Radiation Safety Officer (RSO) as designated in the KDHE Radioactive Materials License 22-B763-01. Only those persons specifically named in the Radioactive Materials License are authorized to use the Niton XRF under the supervision of the RSO. Approved XRF operators must also submit to the regular radiation health monitoring program required by the Radioactive Materials License 22-B763-01. Operators approved by the RSO must also complete manufacturer's training requirements and updates as required by the RSO.

The RSO shall review this SOP at least annually to assure compliance with Radioactive Materials License 22-B763-01 and general safe radioactive materials use practices.

2. METHOD SUMMARY

Elemental analysis of soils, thin filters, sludge and waste can be performed using the Niton XRF. The current method in use for the Niton XRF is the Environmental Protection Agency (EPA) Methods for Solid Waste Analysis (SW-846), Method 6200, *Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment*. Method 6200 and the Niton Model 700 Series manufacturer's manual are incorporated by reference into this SOP.

3. PROCEDURE

XRF analysis is media specific. Modes of operation are either (A) thin sample or (B) bulk.

A. Thin Sample Mode:

This involves preparation of thin filters for sampling from either wipe tests or air sampling filters. The Niton manufacturer's instructions should be consulted for specific instructions and procedures in preparing filter media for analysis. This is also the mode for indoor paint sampling. Indoor paint sampling should be conducted according to accepted U.S. Department of Housing and Urban Development (HUD) standards.

B. Bulk Sample Mode:

Soil, waste and sludge analysis is conducted in this mode and the majority of the Niton XRF use will be in this mode. The Niton must be turned on and allowed a minimum of 15 minutes warm-up time prior to beginning calibration cycle. The time turned on should be recorded on the prepared XRF

field analytical data sheets. The Niton operator's manual contains specific start-up and calibration instructions.

Bulk mode sampling may either be conducted *in-situ* or by homogenizing and drying the sample. If a sample is to be collected for drying and homogenization, sampling should be conducted according to *BER-03, Collection of Soil Samples for Laboratory Analysis*. Samples can either be collected in a clean glass jar or a 1 quart or larger zip-lock freezer bag. Sample drying, homogenization, preparation and analysis should be conducted according to EPA Method 6200. Decontamination of sampling equipment should be in accordance with *BER-05, Decontamination of Sampling Equipment*. All analytical results should be recorded on the prepared XRF field analytical data forms.

4. GENERAL CONSIDERATIONS

- **The shutter should be closed during all transport, storage and calibration of the instrument. The KDHE Radiation Safety Plan must be followed at all times during operation of the Niton XRF.**
- **All site-specific XRF use must be approved by and under the supervision of the RSO.**
- Statistical and data interpretation methods should be performed in accordance with EPA Method 6200 and/or as specified in the site-specific Quality Assurance Project Plan (QAPP).
- Quality control (QC) samples should be obtained and analyzed in accordance with EPA Method 6200 and/or as specified in the site-specific Quality Assurance Project Plan (QAPP).
-

5. SPECIAL CONSIDERATIONS

- **Any operational problems should be reported to the RSO immediately.** Any questions or concerns about XRF operation should be directed to the RSO.
- Storage of the XRF when not in use shall be in the placarded cabinet designated by the RSO. This storage area shall be no less than ten (10) feet from any regularly occupied office or area.

APPENDIX A
STANDARD OPERATING PROCEDURES
KABIS SAMPLER BER-28

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1. INTRODUCTION

The Kabis sampler is a stainless steel discreet interval sampler specifically designed for the collection of environmentally contaminated ground water samples for volatile organic compound (VOC) analysis. The sampler can remove a discreet sample from anywhere in the water column of a well and is designed to eliminate well purging when collecting VOC samples from the screened portion of a well because this part of the water column is in constant communication with the surrounding formation water.

2. OPERATION

Before using the Kabis sampler the static water level should be determined as well as the placement of the well screen. First the sampler body is disassembled from the sampler head (fig. 1). Any standard 40 ml VOC container is then screwed into the bottom of the sampler head. The VOC container should be snugged tight to the sampler head and then unscrewed approximately 1/2 turn to facilitate removal after sampling. Reassemble the sampler body to the sampler head and the unit is now ready for use. The Kabis will fill the VOC container only after it stops descending the well casing. Therefore the sampler must be lowered by rope, twine etc. non-stop until it reaches the sample zone. After allowing 30 seconds to 60 seconds for the sampler to fill, continuously raise the sampler to the surface. Carefully disassemble the sampler body from the sampler head while maintaining it in a vertical position. The VOC container can now be unscrewed from the sampler head and closed with a standard cap or a cap and Sibak Cone (fig.2). The Sibak Cone eliminates the need for a maniscus at the top of the VOC container. If a Sibak Cone is unavailable, and the container does not have enough water, “top off” the vial with additional sample water held in the sampler body of the Kabis Sampler. **Sampling vials that have been pre-preserved cannot be used in this sampler. Preservatives must be added following sample collection, if required.**

3. DECONTAMINATION

The unassembled sampler should be placed vertically in a container of soapy water. The container should be of a depth that allows complete immersion of the sampler, thus flushing the fill tube and vent tube. The Kabis should be rinsed to remove soap residue and given a final rinse with deionized water in accordance with KDHE/BER standard operating procedure BER-05.

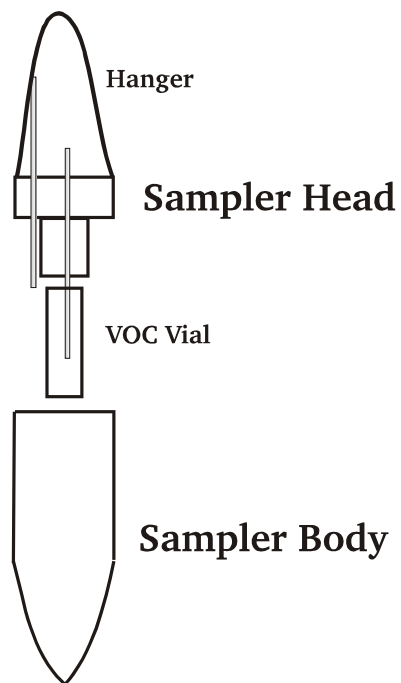


FIGURE 1

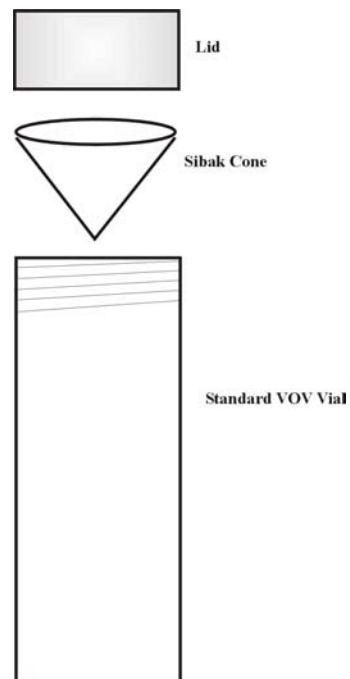


FIGURE 2

APPENDIX A

STANDARD OPERATING PROCEDURE BER-29

INSTALLATION OF DIRECT-PUSH MONITORING WELLS

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5. SPECIAL CONSIDERATIONS	4

1. INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to establish a basic procedure for installation of direct-push monitoring wells for use with KDHE's Geoprobe 5400 and 4200 units. Use of this SOP is limited to KDHE and KDHE contractors. All others who intend to install direct-push monitoring wells must obtain specific permission from KDHE's Bureau of Water (BOW).

2. METHOD SUMMARY

Oversize probe rods (2.125" O.D. or larger) are utilized for installation of small diameter monitoring wells by direct-push technology. Before advancing such wells, the desired total depth, screen interval and aquifer zone to be sampled should be known, since once advanced and completed the sampling interval cannot be adjusted by this method.

Wells may either be installed with a pre-packed assembly which consists of a length of screen surrounded by filter pack material encased in stainless steel wire mesh. These typically come in 3-5 foot lengths. Wells may also be installed with Schedule 80 PVC screen with an appropriate screen size (0.010, 0.020) to correspond to and develop the native aquifer material.

3. PROCEDURE

To install the well, the outer 2.125" diameter rods will be advanced to the target zone. Casing and screen are lowered into the probe rods. The bottom screen section will have a quick-connector mechanism for connection to the disposable anchor point located on the lead rod. A small-diameter static water level indicator or small-diameter steel tape can be used to determine water and filter pack depths. With the casing and screen locked, the rods are pulled up slightly to disengage rods from lead anchor point. Filter pack is then applied with tremie or funnel. The larger-diameter outer rods are slowly pulled to avoid sand locking/bridging. When the filter pack is set at the desired level (minimum of two feet above screened interval), bentonite grout is then pumped with a positive-displacement grout pump until grout returns to the surface. Outer rods are then pulled, and more grout pumped into the hole as rods are pulled to ensure grout returns to surface.

If a pre-packed assembly is not used, sand may be tremied or gravity fed into the annulus. Only clean, environmental or sanitary-grade silica sand is permissible. The filter pack will extend to a minimum of 2 feet above the top of the screened interval. An alternate filter pack design consisting of allowing the native formation to collapse over the desired screened interval is also permissible.

A positive-displacement grouting system is needed to pump grout slurry into the annulus between the 2.125" hole and the 0.5" Schedule 80 casing. A high-solids bentonite slurry of not less than 9.4 lbs/gallon slurry mix consistent with K.A.R. 28-30-2(k)(3) should be utilized. The bentonite grout slurry must be circulated to the surface in order to assure annular seal. A continuous bentonite seal will extend from the top of the filter pack (either pre-packed or placed) to ground surface.

When all outer rods have been pulled from the hole, and grout circulated to the surface from the last large-diameter outer rod, a surface completion consistent with existing regulations will be constructed. Surface completion will consist of either a protective above-ground cover consistent with the existing regulations or a flush-mount cover consistent with existing regulations. Well development should be preformed with a disposable polyethylene tubing and stainless steel check valve assembly, vacuum or peristaltic pump system. Development criteria and desired volume are site-specific and should be determined by the KDHE Project Manager on a site-specific basis.

4. GENERAL CONSIDERATIONS

- Well construction details should be recorded by the on-site geologist or designated person during the well installation.
- Outside diameter rods for the Geoprobe system are typically 2.125" O.D., and 1.5" I.D. An interlocking disposable anchor point is placed on the lead rod. Acceptable well casing and screen is 0.5 " Schedule 80, which may come in 3, 5 or 10 foot lengths. Manufactured screen is also 0.5 " Schedule 80, with typical pre-cut slot sizes (.010, .020, etc.) available.
- Only Schedule 80 casing will be permitted for small-diameter monitoring wells. Only threaded casing will be used, with no glues, solvents, joint compounds or adhesives. Pre-packed screen sections may be used, which consist of screen (in 3-5 foot sections) with a filter pack wrapped by stainless steel mesh. The pre-packed screen sections have a typical outside diameter of 1.5 inches. A positive-displacement grout pump must be used to circulate bentonite slurry to the surface.

5. SPECIAL CONSIDERATIONS

Only a KDHE operator properly trained by the manufacturer (Geoprobe in the case of KDHE's unit) is allowed to install such wells. All flush-mounted well installation will require the standard waiver currently issued for larger-diameter drilled monitoring wells. A WWC-5 form shall be completed for each well installed with KDHE's Geoprobe unit indicating well location and construction specifics.

APPENDIX A

STANDARD OPERATING PROCEDURE BER 30

OPERATION OF THE 2020 PHOTOIONIZATION AIR MONITOR

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ATTACHMENT A - IONIZATION POTENTIALS (IP EV)

1. INTRODUCTION

The purpose of this standard operating procedure (SOP) is to establish general guidelines for the day to day operation of the Perkin-Elmer 2020 Photoionization Air Monitor Detector (PID). The PID measures, displays, and datalogs the total concentration of volatile organic compounds (VOCs). It is non-specific and cannot distinguish between individual compounds. The displayed reading represents the total concentration of all detectable VOCs in parts per million (ppm).

2. WARNING AND SAFETY CONSIDERATIONS

- (1) The instrument is intrinsically safe, however certain procedures such as changing the battery pack and calibration of the instrument must not be performed in locations where flammable concentrations of gases or vapors may exist.
- (2) The calibration gas is in a compressed gas cylinder and must be handled with care.
- (3) When calibrating the PID, adequate ventilation must be provided to prevent threshold limit values (TLV) from being exceeded.
- (4) Exposure of the instrument to prolonged intense sunlight, excessive heat, or excessive cold may result in erroneous readings.

3. EQUIPMENT LIST

- (1) Spare battery pack (fully charged)
- (2) Sample line
- (3) Calibration regulator
- (4) Calibration gas
- (5) AC adapter
- (6) PID

These items are stored in the carrying case, however one should check to make sure that all items are present, and that the batteries are fully charged prior to going to the field.

4. CALIBRATION

- (1) Press the instrument ***On/Off*** key to turn on the instrument. The EPROM software version will be displayed.
- (2) Select ***Enter*** to access the menu.
- (3) Select ***Set***.

- (4) Select **Cal** for calibration.
- (5) Select **Zero** to zero the instrument. This process will take 60-90 seconds. **Zeroing must be preformed in an environment free of VOCs.** A cylinder of ultra zero air may be used to zero the PID, if VOCs are present in ambient air.
- (6) Connect the regulator (Part No. 350006) to the cylinder of calibration gas (isobutylene 100 ppm) and connect the adapter tubing to the instrument.
- (7) Select **Span**. In 1-2 minutes the system will equilibrate and the PID will be calibrated and ready to sample.

The instrument is normally calibrated using a calibration gas cylinder of isobutylene at 100 ppm. The instrument can be calibrated with a particular compound of interest or a response may be programmed into the instrument if the response factor of a compound of interest is known. The instrument can store calibration information for 15 different calibration gases. Refer to the instrument manual for detailed instructions pertaining to calibration using response factors and calibration gases other than isobutylene.

5. OPERATION

Once the instrument is calibrated, it is ready to sample. The reading displayed is the total VOCs being detected by the PID. If the power to the instrument is shut off, the instrument will need to be re-calibrated prior to use. The pump can be shut off between readings by pressing **enter**, **set**, and **pump**. To restart the pump to take the next reading, press **enter**, **set**, and **pump** and the pump will start and the total VOC reading will be displayed.

To shut the instrument off, hold the **On/Off** button down, then release.

For more detailed instruction and other applications of the PID such as calibration using response factors, data logging, direct printing of data, and downloading data to a computer, refer to the 2020 User's Manual.

6. MAINTENANCE

6.1 BATTERY CHARGING: A fully charged battery pack powers the instrument for approximately 8 hours. When **LBat** is displayed, 30 minutes of operation is left. The instrument will shut itself off before the battery pack becomes critically low.

The battery pack is recharged by either using an AC adapter or an off line charger. To charge the battery pack using the AC adapter, plug the AC adapter into the jack located on the back

of the instrument, then plug the AC adapter into an AC outlet. The red LED indicates that the battery is being charged, and the green LED indicates that the battery is fully charged and ready for use. To charge the battery pack using the off line charger, the battery pack is removed from the instrument and plugged into the charger until the green LED is lit, indicating that the battery is fully charged.

6.2 MAINTENANCE OF THE UV LAMP:

1. To replace the UV lamp: turn off the instrument, remove the lamp housing cover with the multi-tool, tilt the instrument slightly, and remove the lamp. **Do not touch the wire grid inside the detector cell. Use a gentle jet of compressed air to blow out any dust or dirt in the detector cell.** Without touching the lamp window, place the new lamp into the lampholder. Replace the old O-ring and lamp spring with the ones supplied with the replacement lamp. Replace the lamp housing cover being careful not to over tighten.
2. To clean the film that builds up on the window of the lamp: Remove the lamp and make sure that it is at room temperature. Dab a cotton swab that has been damped with methanol into the cleaning compound from the cleaning kit. For approximately one minute, gently rub the cleaning compound onto the lamp window using a circular motion. Wipe the window and lamp with a dry, lint free tissue, removing all the cleaning compound and methanol. Replace the lamp into the instrument. **Never use methanol to clean the 11.7 eV Lamp.** To clean the 11.7 eV lamp use the cleaning compound on a dry cotton swab.

6.3 TO REPLACE THE SAMPLE INLET FILTER: Turn off the instrument; unscrew the filter housing from the detector housing, being careful not to lose the O-ring seal; remove the old filter; place the new filter in the filter housing with the polypropylene mesh side facing the instrument; and replace the filter housing.

ATTACHMENT A

Ionization Potentials (IP eV)

<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>	<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>
Acetaldehyde	10.21	X	X	X	3-Bromopropene	9.70	X	X	X
Acetic Acid	10.37		X	X	2-Bromothiophene	8.63	X	X	X
Acetone	9.69	X	X	X	o-Bromotoluene	8.79	X	X	X
Acetonitrile*	12.20	X		X	m-Bromotoluene	8.81	X	X	X
Acetylene*	11.41	X	X	X	p-Bromotoluene	8.67	X	X	X
Acetylene Dichloride	9.80	X		X	1,3-Butadiene	9.07	X	X	X
Acetylene Tetrabromide	n.p.		X	X	2,3-Butadione	9.23	X	X	X
Acrolein	10.10	X	X	X	n-Butanal	9.83	X	X	X
Acrylonitrile	10.91	X	X	X	2-Butanal	9.73	X	X	X
Allene	9.83	X	X	X	n-Butane	10.63	X	X	X
Allyl Alcohol	9.67	X	X	X	2-Butanone	9.53	X	X	X
Allyl Chloride	10.20	X	X	X	iso-Butanol	10.47	X	X	X
Aminoethanol	9.87	X	X	X	sec-Butanol	10.23	X	X	X
2-Aminopyridine	8.34		X	X	tert-Butanol	10.25	X	X	X
Ammonia	10.15	X	X		1-Butene	9.58	X	X	X
n-Amyl Acetate	n.p.	X	X	X	cis-2-Butene	9.13	X	X	X
sec-Amyl Acetate	n.p.	X	X	X	trans-2-Butene	9.13	X	X	X
Aniline	7.70		X	X	n-Butyl Acetate	10.01	X	X	X
Arsine	9.89	X	X		sec-Butyl Acetate	9.91	X	X	X
Benzaldehyde	9.53	X	X	X	t-Butyl Acetate	9.90	X	X	X
Benzene	9.25	X	X	X	n-Butyl Alcohol	10.04	X	X	X
Benzenethiol	8.33	X	X	X	n-Butylamine	8.71		X	X
Benzyl Chloride	9.14	X	X	X	i-Butylamine	8.70		X	X
Bromobenzene	8.98	X	X	X	s-Butylamine	8.70		X	X
1-Bromobutane	10.13	X	X	X	t-Butylamine	8.64		X	X
2-Bromobutane	9.98	X	X	X	n-Butylbenzene	8.69	X	X	X
1-Bromobuanone	9.54	X	X	X	i-Butylbenzene	8.68	X	X	X

<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>	<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>
1-Bromo-2-chloroethane	10.63	X	X	X	t-Butylbenzene	8.68	X	X	X
Bromochloromethane	10.77	X		X	Butyl Cellosolve®	8.68	X	X	X
Bromodichloromethane	10.59	X	X	X	i-Butyl Ethanoate	9.95	X	X	X
1-Bromo-3-chloropropane	n.p.	X	X	X	n-Butyl Mercaptan	9.15	X	X	X
Bromoethane	10.28	X	X	X	t-Butyl Mercaptan	9.03	X	X	X
Bromoethene	9.80	X	X	X	iso-Butyl Mercaptan	9.12	X	X	X
Bromoform	10.48	X	X	X	i-Butyl Methanoate	10.46	X	X	X
1-Bromo-3-hexone	9.26	X	X	X	p-tert-Butyltoluene	8.35	X	X	X
Bromomethane(Methyl Bromide)	10.53	X	X	X	1-Butyne	10.18	X	X	X
Bromomethyl Ethyl Ether	10.08	X	X	X	2-Butyne	9.85	X	X	X
1-Bromo-2-methylpropane	10.09	X	X	X	n-Butyraldehyde	9.86	X	X	X
2-Bromo-2-methylpropane	9.89	X	X	X	Carbon Disulfide	10.13	X	X	
1-Bromopentane	10.10	X	X	X	Carbon Tetrachloride*	11.28	X	X	X
1-Bromopropane	10.18	X	X	X	Cellosolve Acetate	n.p.	X	X	X
2-Bromopropane	10.08	X	X	X	Chloroacetaldehyde	10.16	X	X	X
1-Bromopropene	9.30	X	X	X	Chlorobenzene	9.07	X	X	X
2-Bromopropene	10.06	X	X	X	Chlorobromomethane	10.77	X		X
1-Chloro-2-bromoethane	10.63	X	X	X	1,3-Dibromobutane	n.p.	X	X	X
1-Chlorobutane	10.67	X	X	X	1,4-Dibromobutane	n.p.	X	X	X
2-Chlorobutane	10.65	X	X	X	Dibromochloromethane	10.59	X	X	X
1-Chlorobutanone	9.54	X	X	X	Dibromochloropropane	n.p.	X	X	X
1-Chloro-2,3-epoxypropane	10.60	X	X	X	1,1-Dibromoethane	10.19	X	X	X
Chloroethane(Ethyl Chloride)	10.97	X		X	Dibromomethane	10.49	X	X	X
Chloroethene(Vinyl Chloride)	10.00	X	X	X	1,2-Dibromopropane	10.26	X	X	X
2-Chloroethoxythene	10.61	X	X	X	2,2-Dibromopropane	n.p.	X	X	X
1-Chloro-2-fluorobenzene	9.16	X	X	X	Dibutylamine	7.69		X	X
1-Chloro-3-fluorobenzene	9.21	X	X	X	1,2-Dichlorobenzene	9.07	X	X	X
cis-1-Chloro-2-fluoroethene	9.87	X	X	X	1,3-Dichlorobutane*	n.p.	X	X	X
trans-1-Chloro-2-fluoroethene	9.87	X	X	X	1,4-Dichlorobutane*	n.p.	X	X	X
Chloroform*	11.37	X	X	X	cis-1,4-Dichloro-2-butene	n.p.	X	X	X
o-Chloriodobenzene	8.35	X	X	X	2,2-Dichlorobutane*	n.p.	X	X	X
Chloromethylethyl Ether	10.08	X	X	X	2,3-Dichlorobutane*	n.p.	X	X	X
Chloromethylmethyl Ether	10.25	X	X	X	3,4-Dichlorobutane*	n.p.	X	X	X

<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>	<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>
1-Chloro-2-methylpropane	10.66	X	X	X	1,1-Dichloroethane*	11.06	X	X	X
Chloroprene	8.83	X	X	X	1,2 Dichloroethane (Ethylene Dichloride)*	11.04	X	X	X
1-Chloropropane*	10.82	X	X	X	cis-1,2-Dichloroethene	9.65	X	X	X
2-Chloropropane*	10.78	X	X	X	trans-1,2-Dichloroethene	9.66	X	X	X
3-Chloroprene	10.04	X	X	X	1,1-Dichloroethene	10.00	X	X	X
p-Chlorostyrene	n.p.	X	X	X	Dichloroethyl Ether	n.p.	X	X	X
2-Chlorothiophene	8.68	X	X	X	Dichloromethane (Methylene Chloride)*	11.35	X	X	X
o-Chlorotoluene	8.83	X	X	X	1,2-Dichloropropane*	10.87	X	X	X
m-Chlorotoluene	8.83	X	X	X	1,3-Dichloropropane*	10.85	X	X	X
p-Chlorotoluene	8.70	X	X	X	1,1-Dichloropropanone	9.71	X	X	X
o-Cresol	8.48		X	X	2,3-Dichloropropene	9.82	X	X	X
m-Cresol	8.48		X	X	Dicyclopentadiene	7.74	X	X	X
p-Cresol	8.48		X	X	Diethoxymethane	9.70	X	X	X
Cumene (i-Propyl Benzene)	8.75	X	X	X	Diethylamine	8.01		X	X
Crotonaldehyde	9.73	X	X	X	Diethylaminoethanol	8.58		X	X
Cyanoethene*	10.91	X	X	X	Diethyl Ether	9.53	X	X	X
Cyanogen Bromide*	10.91	X	X		Diethyl Ketone	9.32	X	X	X
3-Cyanopropene	10.39	X	X	X	Diethyl Sulfide	8.43	X	X	X
Cyclobutane	10.50	X	X	X	1,2-Difluorobenzene	9.31	X	X	X
Cyclohexane	9.98	X	X	X	1,4-Difluorobenzene	9.15	X	X	X
Cyclohexanol	10.00	X	X	X	Difluorodibromomethane*	11.18	X		X
Cyclohexanone	9.14	X	X	X	Difluoromethylbenzene	9.45	X	X	X
Cyclohexene	8.95	X	X	X	Diiodomethane	9.34	X	X	X
Cyclo-octatetraene	7.99	X	X	X	Diisobutyl Ketone	9.04	X	X	X
Cyclopentadiene	8.55	X	X	X	Diisopropylamine	7.73		X	X
Cyclopentane	10.52	X	X	X	1,1-Dimethoxyethane	9.65	X	X	X
Cyclopentanone	9.26	X	X	X	Dimethoxymethane	10.00	X	X	X
Cyclopentene	9.01	X	X	X	Dimethylamine	8.24		X	X
Cyclopropane	10.06	X	X	X	Dimethylaniline	7.13		X	X
2-Decanone	9.40	X	X	X	2,3-Dimethylbutadiene	8.72	X	X	X
Diacetone Alcohol	n.p.	X	X	X	2,2-Dimethylbutane	10.06	X	X	X

<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>	<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>
2,2-Dimethylbutan-3-one	9.18	X	X	X	mono-Fluorobenzene	9.20	X	X	X
2,3-Dimethylbutane	10.02	X	X	X	mono-Fluoroethene	10.37	X	X	X
2,3-Dimethyl-2-butene	8.30	X	X	X	mono-Fluoromethanal	11.40	X	X	X
3,3-Dimethylbutanone	9.17	X	X	X	Fluorotribromomethane	10.67	X	X	X
Dimethyl Disulfide	8.46	X	X	X	o-Fluorotoluene	8.92	X	X	X
Dimethyl Ether	10.00	X	X	X	m-Fluorotoluene	8.92	X	X	X
Dimethylformamide	9.45		X	X	p-Fluorotoluene	8.79	X	X	X
3,5-Dimethyl-4-heptanone	9.04	X	X	X	Formaldehyde	10.88	X		
1,1-Dimethylhydrazine	8.88		X	X	Freon 11 (Fluorotrichloromethane)	11.77	X		X
2,2-dimethyl-3-pentanone	8.98	X	X	X	Freon 12 (Dichlorodifluoromethane)	12.91	X		X
2,2-Dimethylpropane	10.35	X	X	X	Freon 13 (Chlorotrifluoromethane)	12.91	X		X
Dimethyl Sulfide	8.69	X	X	X	Freon 13 B-1 (Bromotrifluoromethane)	12.08	X		X
Di-n-propyl Disulfide	8.27	X	X	X	Freon 14 (Carbon Tetrafluoride)	16.25	X		X
Di-n-propyl Ether	9.27	X	X	X	Freon 21 (Dichlorofluoromethane)	12.00	X		X
Di-i-propyl Ether	9.20	X	X	X	Freon 22 (Chlorodifluoromethane)	12.45	X		X
Di-n-propylamine	7.84		X	X	Freon 113 (1,2-Dichlorotrifluoroethane)	11.78	X		X
Di-n-propyl Sulfide	8.30	X	X	X	Furan	8.89	X	X	X
1,4-Dioxane	9.41	X		X	Furfuryl Alcohol	n.p.	X	X	X
Epichlorohydrin	10.60	X	X	X	furfural	9.21	X	X	X
Ethane*	11.65	X	X	X	n-Heptane	10.07	X	X	X
Ethanol	10.62	X	X	X	2-Heptanone	9.33	X	X	X
Ethanolamine	9.87		X	X	4-Heptanone	9.12	X	X	X
Ethanethiol (Ethyl Mercaptan)	9.29	X	X	X	n-Hexane	10.18	X	X	X
Ethene(Ethylene)	10.52	X	X	X	Hexanone	n.p.	X	X	X
Ethyl Acetate	10.11	X	X	X	2-Heanone	9.44	X	X	X
Ethyl Acrylate	n.p.	X	X	X	1-Hexene	9.46	X	X	X
Ethylamine	8.86		X	X	sec-Hexyl Acetate	n.p.		X	X
Ethyl Amyl Ketone	9.10	X	X	X	Hydrazine	n.p.	X	X	X
Ethylbenzene	8.76	X	X	X	Hydrogen Selenide	9.88	X	X	

<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>	<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>
Ethyl Bromide	10.29	X	X	X	Hydrogen Sulfide	10.46	X	X	
Ethyl Butyl Ketone	9.02	X	X	X	Hydrogen Telluride	9.14	X	X	
Ethyl Chloride	11.01	X		X	Iodobenzene	8.73	X	X	X
Ethyl Chloroacetate	10.20	X	X	X	1-Iodobutane	9.21	X	X	X
Ethyl Ethanoate	10.10	X	X	X	2-Iodobutane	9.09	X	X	X
Ethyl Ether	9.41	X	X	X	Iodoethane (Ethyl Iodide)	9.33	X	X	X
Ethyl Disulfide	8.27	X	X	X	Iodomethane (Methyl Iodide)	9.54	X	X	X
Ethylene Chlorohydrin	10.90	X	X	X	1-Iodo-2-methylpropane	9.18	X	X	X
Ethylene Dibromide (EDB)	10.37	X	X	X	1-Iodo-2-methylpropane	9.02	X	X	X
Ethylene Oxide	10.56	X	X	X	1-Iodopentane	9.19	X	X	X
Ethyl Formate	10.61	X	X	X	1-Iodopropane	9.26	X	X	X
Ethyl Iodide	9.33	X	X	X	2-Iodopropane	9.17	X	X	X
Ethyl Mercaptan	9.29	X	X	X	o-Iodotoluene	8.62		X	X
Ethyl Methanoate	10.61	X	X	X	m-Iodotoluene	8.61		X	X
Ethyl Isothiocyanate	9.14	X	X	X	p-Iodotoluene	8.50		X	X
Ethyl Methyl Sulfide	8.55	X	X	X	Isoamyl Acetate	9.90	X	X	X
Ethyl Propanoate	10.00	X	X	X	Isoamyl Alcohol	10.16	X	X	X
Ethyl Trichloroacetate	10.44	X	X	X	Isobutane	10.57	X	X	X
Isobutylamine	8.70		X	X	Methyl Isobutyl Ketone(MIBK)	9.30	X	X	X
Isobutyl Acetate	9.97	X	X	X	Methyl Isobutyrate	9.98	X	X	X
Isobutyl Alcohol	10.47	X	X	X	Methyl Isocyanate	10.67		X	X
Isobutyl Formate	10.46	X	X	X	1-Methyl-4-isopropylbenzene	n.p.	X	X	X
Isobutylene	9.43	X	X	X	Methyl Isopropyl Ketone	9.32	X	X	X
Isobutyraldehyde	9.74	X	X	X	Methyl Mercaptan (Methanethiol)	9.44	X	X	X
Isopentane	10.32	X	X	X	Methyl Methacrylate	9.74	X	X	X
Isoprene	8.85	X	X	X	Methyl Methanoate	10.82	X		X
Isopropyl Acetate	9.99	X	X	X	2-Methylpentane	10.12	X	X	X
Isopropyl Alcohol	10.16	X	X	X	3-Methylpentane	10.08	X	X	X
Isopropylamine	8.72		X	X	2-Methylpropane	10.56	X	X	X
Isopropylbenzene	8.75	X	X	X	2-Methylpropanal	9.74	X	X	X
Isopropyl Ether	9.20	X	X	X	2-Methyl-2-propanol	9.70	X	X	X
Isovaleraldehyde	9.71	X	X	X	2-Methylpropene	9.23	X	X	X

<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>	<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>
Ketene	9.61	X	X	X	Methyl n-propyl Ketone	9.39	X	X	X
Mesitylene	8.40	X	X	X	Methyl Styrene	8.35	X	X	X
Mesityl Oxide	9.08	X	X	X	Monomethyl Hydrazine	8.00	X	X	X
Methane	12.98	X		X	Naphthalene	8.10	X	X	X
Methanol*	10.85	X		X	Nitric Oxide	9.25	X	X	
Methyl Acetate	10.27	X	X	X	Nitrobenzene	9.92		X	X
Methyl Acrylate	10.72	X		X	p-Nitrochlorobenzene	9.96		X	X
Methylamine	8.87		X	X	n-Nonane	10.21	X	X	X
Methyl Bromide (Bromomethane)	10.53	X	X	X	5-Nonanone	9.10	X	X	X
2-Methyl-1,3-butadiene	8.85	X	X	X	n-Octane	10.24	X	X	X
2-Methylbutanal	9.71	X	X	X	3-Octanone	9.19	X	X	X
2-Methylbutane	10.31	X	X	X	4-Octanone	9.10	X	X	X
2-Methyl-1-butene	9.12	X	X	X	1-Octene	9.52	X	X	X
3-Methyl-1-butene	9.51	X	X	X	n-Pentane	10.53	X	X	X
3-Methyl-2-butene	8.67	X	X	X	cis-1,3-Pentadiene	8.59	X	X	X
Methyl tert-Butyl Ether	9.41	X	X	X	trans-1,3-Pentadiene	8.56	X	X	X
Methyl n-Butyl Ketone	9.34	X	X	X	n-Pentanal	9.82	X	X	X
Methyl Butyrate	10.07	X	X	X	2,4-Pentanedione	8.87	X	X	X
Methyl Cellosolve	n.p.	X	X	X	2-Pentanone	9.39	X	X	X
Methyl Cellosolve Acetate	n.p.	X	X	X	3-Pentanone	9.32	X	X	X
Methyl Chloroacetate	10.35	X	X	X	1-Pentene	9.50	X	X	X
Methylchloroform (1,1,1-TCA)*	11.25	X	X	X	Perfluoro-2-butene*	11.25	X		X
Methylcyclohexane	9.85	X	X	X	Perfluoro-1-heptene	10.48	X	X	X
Methylcyclohexanol	9.80	X	X	X	n-Perfluoropropyl Iodide	10.36		X	X
Methylcyclohexanone	9.05	X	X	X	n-Perfluoropropyl- iodomethane	9.96	X	X	X
4-Methylcyclohexene	8.91	X	X	X	n-Perfluoropropyl-methyl Ketone	10.58	X	X	X
Methylcyclopropane	9.52	X	X	X	Phenol	8.69		X	X
Methyl Dichloroacetate	10.44	X	X	X	Phenyl Ether	8.09	X	X	X
Methyl Ethanoate	10.27	X	X	X	Phenyl Isocyanate	8.77	X	X	X
Methyl Ethyl Ketone (MEK)	9.53	X	X	X	Phosphine	9.96	X	X	
Methyl Ethyl Sulfide	8.55	X	X	X	Pinene	8.07	X	X	X

<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>	<i>Compound</i>	<i>IP (eV)</i>	<i>GC</i>	<i>PID</i>	<i>FID</i>
2-Methyl Furan	8.39	X	X	X	Propadiene	10.19	X	X	X
Methyl Iodide	9.54	X	X	X	n-Propanal	9.95	X	X	X
Propane*	11.07	X	X	X	1,2,3-Trichloropropane	n.p.	X	X	X
1-Propanethiol	9.20	X	X	X	Triethylamine	7.50	X	X	X
n-Propanol	10.51	X	X	X	1,2,4-Trifluorobenzene	9.37	X	X	X
Propanone	9.69	X	X	X	1,3,5-Trifluorobenzene	9.32	X	X	X
Propene	9.73	X	X	X	Trifluoroethene	10.14	X	X	X
Prop-1-ene-2-ol	8.20	X	X	X	1,1,1-Trifluoro-2-iodoethane	10.10	X	X	X
Prop-2-ene-1-ol	9.67	X	X	X	Trifluoroiodomethane	10.40	X	X	X
Propionaldehyde	9.98	X	X	X	Trifluoromethylbenzene	9.68	X	X	X
n-Propyl Acetate	10.04	X	X	X	Trifluoromethylcyclohexane	10.46	X	X	X
n-Propyl Alcohol	10.20	X	X	X	1,1,1-Trifluoropropene	10.90	X	X	X
n-Propylamine	8.78		X	X	Trimethylamine	7.82	X	X	X
n-Propylbenzene	8.72	X	X	X	2,2,4-Trimethyl Pentane	9.86	X	X	X
Propylene	9.73	X	X	X	2,2,4-Trimethyl-3-pentanone	8.82	X	X	X
Propylene Dichloride	10.87	X	X	X	n-Valeraldehyde	9.82	X	X	X
Propylene Imine	8.76	X	X	X	Vinyl Acetate	9.19	X	X	X
Propylene Oxide	10.22	X	X	X	Vinyl Bromide	9.80	X	X	X
n-Propyl Ether	9.27	X	X	X	Vinyl Chloride (Chloroethene)	10.00	X	X	X
n-Propyl Formate	10.54	X	X	X	4-Vinylcyclohexene	8.93	X	X	X
Propyne	10.36	X	X	X	Vinyl Ethanoate	9.19	X	X	X
Pyridine	9.32		X	X	Vinyl Fluoride	10.37	X	X	X
Styrene	8.47	X	X	X	Vinylidene Chloride (1,1-DCE)	10.00	X	X	X
Tetrabromoethane	n.p.	X	X	X	Vinyl Methyl Ether	8.93	X	X	X
Tetrachloroethylene (PCE)	9.32	X	X	X	o-Vinyl Toluene	8.20		X	X
1,1,1,2-Tetrachloropropane	n.p.	X	X	X	o-Xylene	8.56	X	X	X
1,1,2,2-Tetrachloropropane	11.10	X	X	X	m-Xylene	8.56	X	X	X
Tetrafluoroethene	10.12	X	X	X	p-Xylene	8.45	X	X	X
Tetrahydrofuran	9.54	X	X	X	2,4-Xylidine	7.65		X	X
1,1,1,2-Tetrachloropropane	n.p.	X	X	X	Trichloroethylene (TCE)	9.45	X	X	X
1,1,2-Trichloroethane*	11.00	X	X	X	Trichloromethyl Ethyl Ether	10.08	X	X	X

* The sensitivity of these compounds are enhanced using an 11 eV lamp instead of the standard 10.6 eV lamp.

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APPENDIX A

STANDARD OPERATING PROCEDURE BER 31

FIELD-BASED COLORIMETRIC ANALYSIS

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1. INTRODUCTION

The purpose of this standard operating procedure (SOP) is to establish general guidelines for field-based analytical and field screening procedures using colorimetric analyses. Enzyme immunoassay test kits, colorimetric tubes, and colorimetric test strips are covered by this SOP.

2. ENZYME IMMUNOASSAY TEST KITS

Immunoassay screening methods may be used for the determination of herbicides, insecticides, fungicides and various water quality parameters such as hydrocarbon contaminants, hydrofluor-combo cryptosporidium/giardia, THMs, and water treatment polymers. Depending on the type of enzyme immunoassay test kit used, analytical results may be qualitative, semi-quantitative, or quantitative. Because the test kits have a limited shelf life, test kits are ordered as needed for specific projects. Many of the pesticides can be analyzed in water and soil samples.

Generally the procedure consists of a sample or a control and a enzyme-labeled analyte conjugate being added to a test tube that has been coated with an antibody that is capable of binding the analyte of interest. Incubation for a specified period of time allows the target analyte in the sample or control and enzyme-labeled analyte conjugate to competitively bind to the antibody binding sites on the test tube wall in direct proportion to their relative concentration. The sample and conjugate are removed from the test tube after incubation. Substrate and chromagen are added to the test tube. The substrate is converted by the antibody bound enzyme-labeled analyte conjugate to a compound which reacts with the chromagen to produce a color. The produced color from the sample tubes is then compared to color from the controls either visually or with the use of a spectrophotometer. The color development is proportional to the enzyme-labeled analyte and inversely proportional to the concentration of the sample analyte, because only the conjugate reacts with the substrate and chromagen to produce color. Therefore the less color produced indicates a higher concentration of the targeted analyte.

To analyze soil samples, an extraction has to be performed on the soil samples prior to analysis using a soil extraction kit. The extract is then analyzed using the appropriate method. Depending on the analyte, the procedure may be the same for water analysis and soil extracts.

The procedure varies for each analyte analyzed using immunoassay test methods. The manufacturer's instructions, which are included with each test kit, are followed when using an immunoassay test kit.

3. COLORIMETRIC TUBES

3.1 PRINCIPLE

Colorimetric tubes are used to analyze compounds in a gas or vapor sample. A solid chemical reagent, which is analyte specific, is housed in a closed glass tube. A gas or vapor is passed through the tube by breaking the glass seal on each end of the tube and pumping a sample through the tube. If the target analyte is present, a color change will be observed in the chemical reagent. The concentration of the target analyte is characterized by the length of the color change in the tube. The glass tube has graduations printed on the tube and the concentration of the target analyte can be read directly off the tube. The amount of air drawn through the tube depends on the type and sensitivity of the reagent system.

With the appropriate preparation air, water and soil samples can be analyzed with colorimetric tubes.

A bellows-type hand pump is used to draw the sample through the tube. Only pumps that are specifically designed to be used with colorimetric tubes can be used. The pumps are designed to deliver a precise volume of air with each pumping action. The volume of gas passing through the colorimetric tube is critical for proper color formation.

3.2 SAMPLING PROCEDURE

- (1) Prior to sampling check the pump for leaks with an unopened tube.
- (2) Break off both tips of the colorimetric tube.
- (3) Insert the tube tightly in the pump with the arrow pointing towards the pump.
- (4) Perform the required number of pump strokes. For each stroke the pump should be squeezed completely together and allowed to fully extend before starting the next stroke.
- (5) Read the concentration at the end of the color zone within the time specified by the method. NOTE: When interrupting the results, take into account interferences and cross sensitivities which are listed in the instructions.

3.3 OTHER CONSIDERATIONS

The procedure for using colorimetric tubes is essentially the same for all analytes. The amount of sample that is required for each analyte is specific. The number of strokes to use is found in the instruction sheet. Other important information listed on the instruction sheet are: (1) the application range of the colorimetric tube, (2) acceptable pumps that can be used, (3) the

principle of the reaction and color change, (4) ambient conditions during sampling, (5) storage and transport information, and (6) interferences. The expiration date is listed on the package. Colorimetric tubes should not be used past their expiration date.

4. MERCKOQUANT NITRATE TEST STRIPS

4.1 PRINCIPLE - Merckoquant nitrate test strips are used as a quick and easy method for a semi-quantitative analysis of nitrate in water and soil samples. The test strip has two reaction pads on one end of the strip. One of the reaction pads reacts with nitrite in the sample. The other reaction pad contains a reducing agent that reduces nitrate to nitrite.

4.2 PROCEDURE FOR WATER SAMPLES

1. Remove a test strip from tube and immediately replace stopper.
2. Dip the test strip into the sample for one second making sure that both reaction pads are wetted.
3. Shake off excess sample and allow to sit for one minute protected from direct sun light.
4. Compare the color formed on the reaction pad with the color chart found on the test strip container, estimating the values that fall between the concentrations shown on the color chart.

Note: The nitrate values on the color chart are expressed as NO_3 . To convert the results to Nitrate as N, divide the results by 4.5.

Soil samples can be analyzed using the nitrate test strip by mixing equal amounts of soil and distilled or de-ionized water and analyzing the extract. The soil/water mixture may have to be filtered to obtain a clear enough sample to analyze.

Unopened test strips should be stored in a refrigerator. Once the package has been opened the pack should be kept as dry and cool as possible, but not in a refrigerator. Atmosphere moisture will condense in the cool tube, exceeding the capacity of the drying agent in the stopper.

Merckoquant test strips are available to analyze several other anions and cations.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-32

GARMIN MODEL GPS III +

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Attachments: Site Location/Identification Data Collection Form

Division of Environment SOP, Aug. 4, 2000

1. INTRODUCTION:

The global positioning system (GPS) is a government administered system of 24 satellites which circle the earth twice per day and transmit information back to earth. GPS units receive signals from at least three satellites in order to calculate position and track movements. Upon initialization GPS units find themselves by using available satellites and an *almanac* (timetable of satellite numbers and their orbits) which is stored in the units memory.

2. HOW TO USE THE GPS III +

2.1. OPERATION:

Before the unit is used for the first time it must be initialized. Initialization is the process whereby the gps unit finds itself in relation to the satellites. The gps unit will be initialized at Forbes Field thus there is no need to re-initialize unless the user travels over 500 miles with the unit off.

- (1.) Depress red button to turn unit On or Off.
- (2.) The screens will automatically scroll to the Acquiring Satellites page.
- (3.) Use the page button to advance to the position page, the acquisition of latitude and longitude takes less than a second.
- (4.) Once latitude and longitude are obtained , press the ENTER/MARK button to bring up the Mark Waypoint page.
- (5.) Use the rocker pad to highlight the upper left name field; press Enter. The waypoint can be given a unique name up to 6 characters (numbers and/or letters). When finished, press enter. Highlight DONE and press enter.

2.2 USER SETTINGS:

All unit settings will be entered into the gps units before being released for field use and are not to be altered in the field. The operator can check to insure that the following settings are entered by accessing the various menus and submenus per the Garmin GPS III + owners manual.

Units,

- * Distance and Speed = statute
- * Heading = true
- * Altitude/Elevation = feet

Time,

- * Time Format = local 24 hr.
- * Local Time Zone = 06:01 Behind UTC

Position,

- * Position Format = hddd.dddd (decimal degrees)
- * Map Datum = wgs 84

Interface,

- * Format = Garmin
- * Transfer Mode = host

2.3 AVERAGING:

Averaging reduces the effects of selective availability on position and **may** give a more accurate reading in the absence of selective availability. Averaging can be used when the collection points are close together. Refer to the division SOP and the owners manual for detailed averaging instructions.

3. DATA COLLECTION FORM:

The DATA COLLECTION FORM is to be used for all BER sites either in hard copy or on computer. The procedure for obtaining GPS data will depend on the type or size of the site. The guideline for each type are as follows:

- (1.) Area of Concern (AOC) - a large area containing multiple source areas. The four corners of the large area as well as each *source facility* within the area are GPS ed and listed on separate Site Identification/Location forms.
- (2.) Source Facility - the individual source areas within an AOC. Each source facility should have GPS data collected at or near the entrance and be assigned an individual project code.
- (3.) Individual Sites/Properties - If the site is 5 acres or less in size, a GPS point should be collected from the approximate center. If the site is greater than 5 acres, GPS data should

be collected at the approximate 4 corners of the property. Additionally, for any size individual site, 2 to 5 GPS points should be collected around the toe of the ground water plume.

The Garmin GPS III + is a fully downloadable unit using Map Source software. Refer to the division SOP for downloading instructions and additional information concerning navigational use of the GPS III +.

ATTACHMENT A

Data Collection Form

DATA COLLECTION FORM

I. SITE INFORMATION

Check the type of site marked ☐ Area of Concern ☐ Source Facility ☐ Individual Site/Property
Size of Site ☐ Over 5 acres ☐ Less than 5 acres

Site Name: _____

Site Address: _____

City: _____ County: _____ Zip: _____

Indicate whether this site is a current site or a new site. ☐ New ☐ Current

Project Code: _____

Linked Area of Concern Project Code: _____

Name of the Respondent: _____

(Signatory to the Consent Order, VCP Agreement or other document)

II. LOCATION INFORMATION

General Legal Description of Site:

_____ of Section _____ Township _____ N/S, Range _____ E/W
quarter sections

NW Corner Coordinates

SITE LATITUDE: _____ Degrees, **NORTH**

SITE LONGITUDE: _____ Degrees, **WEST**

NE Corner Coordinates

SITE LATITUDE: _____ Degrees, **NORTH**

SITE LONGITUDE: _____ Degrees, **WEST**

SW Corner Coordinates

SITE LATITUDE: _____ Degrees, **NORTH**

SITE LONGITUDE: _____ Degrees, **WEST**

SE Corner Coordinates

SITE LATITUDE: _____ Degrees, **NORTH**

SITE LONGITUDE: _____ Degrees, **WEST**

Center Coordinates

SITE LATITUDE: _____ Degrees, **NORTH**

SITE LONGITUDE: _____ Degrees, **WEST**

End of Plume Coordinates

SITE LATITUDE: _____ Degrees, **NORTH**

SITE LONGITUDE: _____ Degrees, **WEST**

SITE LATITUDE: _____ Degrees, **NORTH**

SITE LONGITUDE: _____ Degrees, **WEST**

SITE LATITUDE: _____ Degrees, **NORTH**

SITE LONGITUDE: _____ Degrees, **WEST**

If more coordinates are needed add to back of form.

Data was collected by (check one): ☐ Legal Survey(highest quality) ☐ Ashtech GPS ☐ Magellen GPS
☐ Garmin GPS ☐ Topomap or Aerial Photo ☐ Legal Description Conversion ☐ Address Search

Photographs Taken: ☐ Yes ☐ No

Collector's Name: _____ Bureau/Section: _____

Area of Concern- The “area of concern” (AOC) can be defined as a larger site with multiple sources. Example sites include 4th and Carey, Gilbert and Mosley, and N.I.C. For these types of sites mark the four corners of the known/defined boundaries. This polygon is termed the “area of concern”. One Site Location/Identification form should be completed for each AOC using the current project code. Each known source facility within the AOC should be identified on a separate Site Location/Identification form in accordance with the procedure outlined under Source Facility.

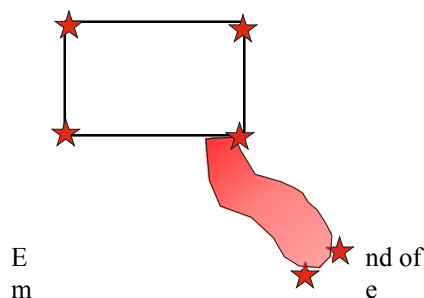
Source Facility- All known source facilities (different facilities/responsible parties) within the known AOC should be marked at the entrance to the source facility or an otherwise designated program specific location. Each source facility should also be assigned an individual project code if they are located within the known AOC. A link will be made by the database tying in the source facility to the overall AOC. Example sites include Coleman Downtown ro Harcross Chemical within Gilbert and Mosley.

Individual Sites/Properties- If less than 5 acres mark the approximate center of the individual property/site. The current project code should be used for site identification. An additional 2 to 5 locations should mark the approximate known toe of the ground water plume.

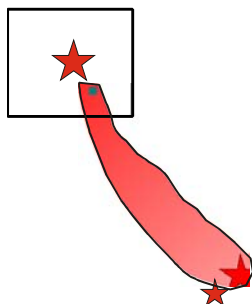
If greater than 5 acres mark the four corners of the known/defined boundaries of the individual property/site. The current project code should be used for site identification. An additional 2 to 5 locations should mark the approximate known toe of the ground water plume.

Respondent- The Name of the “respondent” is the entity that is working with KDHE such as a Potential Responsible Party (PRP) for State Cooperative Program; Voluntary Party (VP) for State Voluntary Program; Municipality or County for Landfills or Brownfields Project; Owners or Operators for the Tank Program or Dry Cleaner Program; EPA for a federal lead removal or Superfund Project; KDHE for a orphan site State Water Plan project; and unknown for new sites where a PRP has not been determined.

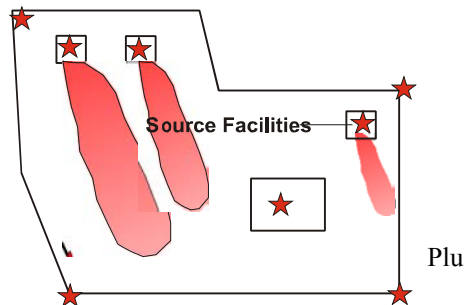
>5 acre individual facility



<5 acre individual facility



Area of Concern-Multi-Site



- location of where GPS points should be collected.



ATTACHMENT B

Division of Environment
Standard Operating Procedure
for the Garmin GPS III+

Description & Purpose

This Standard Operating Procedure (SOP) will outline the functionality of the Garmin GPS III+ for the Division of Environment (DOE). However, you should check your Bureau's/Program's SOPs to determine whether you need to follow additional guidelines while using the Garmin GPS III+. The Garmin GPS III+ is a handheld navigation tool to be used primarily to assist field staff to find a predetermined location (sample point/area), to determine spatial relationships, and to mark locations of interest for computer database entry and mapping.

1. Applicability

- a. The Garmin GPS III+ has a horizontal positional accuracy of **4-7 meters (12-20 ft.)** with Selective Availability (SA) off and good satellite coverage. If the satellite coverage is limited (less than 4) the accuracy could drop to **10-20 meters (33-66 ft.)**. The unit can be used for navigation, and to acquire point location for general information, such as the front gate of a facility.
- b. The unit can be used to locate specific sampling sites (such as monitoring wells or air sampler locations) where the relative location between sites is important as long as individual sites are not within **40 meters (132 ft.)** of each other. If greater levels of accuracy are required, for detailed mapping or legal definition, the user should consider using the AshTech Reliance system, the Magellan ProMark system or conventional land surveys.
- c. The unit can be used to map points for GIS features with the restriction that polygons of less than **40 meters (132 ft.)** on a side may not reproduce well in the mapping software. If higher levels of accuracy are required and/or the information will be used primarily for mapping, the user should consider using the AshTech Reliance system, the Magellan ProMark system or conventional land surveys.
- d. This procedure applies to the Garmin GPS III+ units only. The elements of this SOP will be applicable to all Garmin GPS III+ deployed within the Division of Environment.
- e. Operators/staff collecting data for databases/mapping shall conform to the GIS unit's SOPs.
- f. This SOP will describe the necessary training for field operation, maintenance, and troubleshooting of the Garmin GPS III+.

2. Minimal Technical Qualifications and Training of Operator

- a. The operator shall be familiar with all applicable procedures described in the operator's manual.
- b. The operator shall be familiar with this SOP and any applicable Bureau/Program SOPs.
- c. The Bureau's/Program's GPS Administrator verifies who is ready to operate the unit.

3. Operational Instructions

- a. The operator shall inspect the GPS unit and related equipment for proper, safe operation before going to the field. Any problems with the unit detected by the operator shall be reported to his/her Bureau's/Program's GPS Administrator. Refer to the troubleshooting section for additional information.
- b. The Garmin web site (<http://www.garmin.com/support>) should be visited periodically by the Bureau's/Program's GPS Administrator to check for the availability of product updates for the GPS III+ operating software and/or the *MapSource*® software.
- c. Unless permission has been given beforehand by the Bureau's/Program's GPS Administrator, only he/she may delete waypoints or change settings on the unit.
- d. Operators should be mindful of the quality of all data to be submitted for database and mapping purposes, and should keep appropriate documentation to validate their data sets.

4. Initial Calibration of Unit

- a. Allow the unit approximately five minutes to **AutoLocate** itself under the following circumstances.
 - i. The first time it is used out of the box.
 - ii. After it has been moved with the power off over 500 miles from last usage point.
 - iii. If it's memory has been cleared and all internally stored data has been lost.
 - iv. After a software update.
- b. The following procedure describes how to change the settings that need to be changed by each Bureau's/Program's GPS Administrator before the unit is given out for field data collection.
 - i. From any screen press the MENU button twice to bring up the **Main Menu** screen.
 - ii. Highlight **Setup** and press the ENTER/MARK button.
 - iii. Using the rocker keypad select the **Time** tab at the top of the screen.
 - iv. Select the **Time Format** field and press the ENTER button.
 - v. Highlight **UTC** and press the ENTER button.
 - vi. Select the **Time** tab at the top of the screen and move to the **Position** screen.
 - vii. Select the **Position Format** field and press the ENTER button.

- viii. Highlight **hddd.ddddd°** and press the ENTER button.
- ix. All remaining user settings leave at default values.
- x. Press the QUIT button once to return to the **Main Menu** screen and twice to return to the screen you started out at.

5. Using the GPS III+ Unit

- a. Try to give the antenna a clear and unobstructed view of the sky.
- b. Turn the unit on by pressing and holding the red POWER button until the screen turns on.
- c. Allow the unit approximately one minute to acquire satellite information. Do not move the unit during this process.
- d. After the unit has switched from the **Satellite Status Page** to the **Map Page**, it is ready for use. If you switch back to the **Satellite Status Page**, it should read **3D Navigation** at the top of the screen.
- e. The unit has six main pages that are linked together and provide content related information to the user. Pressing the PAGE key moves through the main pages in normal fashion. The QUIT key moves through the pages in reverse order.
- f. Each page has a menu screen used to change fields/settings or input data. The menu screens can be accessed by pressing the MENU button. Once on one of these menu screens, pressing the MENU button again will bring up the **Main Menu** for the unit, where you can access the **Setup** screen along with other features.
- g. Turn the unit off by pressing and holding the red POWER button until the screen turns off.

6. Data Collection Procedures

- a. Waypoint naming convention
 - i. Before the unit is taken out in the field a suitable naming convention will be developed between the Bureau's/Program's GPS Administrator and the field operator.
 - ii. One suggestion is to have the person in charge of the unit set a "dummy" waypoint at a predetermined three digit number, such as 500, before it is handed out.
 - iii. After this "dummy" waypoint is set, each new waypoint collected out in the field will be automatically numbered consecutively by the unit starting with 501, 502, 503, ...
 - iv. If this method is used you may skip steps **6.2.3.1-6.2.3.4**, because you will not need to alter the name of the waypoint.
 - v. A log should be taken out in the field to record and link the waypoint name/number with a more detailed description of the location. This log can then be used to identify the waypoints by the three digit waypoint numbers stored by the unit. This is necessary because the unit can only store six characters in the waypoint name field; many times more than six characters are needed to describe the point.
 - vi. The information included in the log can later be added to the ASCII text file created when the data is processed. See **7.2.18** of this document.
- b. Instant reading waypoint collection
 - i. Go to either the **Map Page** or **Position Page**.
 - ii. With the unit held steady at the desired location, hold down ENTER/MARK button until **Mark Waypoint** screen pops up.
 - iii. If you wish to change the waypoint name/number follow steps **6.2.3.1-6.2.3.4** below, otherwise skip to **6.2.4**.
 - (1) Highlight the name field to the left of '**Done**' using the rocker keypad and press the ENTER button.
 - (2) Input a name for the waypoint by using the rocker keypad. Up and down go through the available characters. Left and right changes the position of the cursor. The waypoint name can be up to six characters.
 - (3) Press the ENTER button to store the edited waypoint name.
 - (4) Use the rocker keypad to highlight '**Done**'.
 - iv. Press the ENTER button to save your position.
 - v. Write down any additional data about the waypoint on a log sheet.
- c. Average position waypoint collection
 - i. Follow **6.2.1** through **6.2.3** of the above procedure.
 - ii. With the unit in the same position that the waypoint was taken, press the MENU button, highlight **Average Position** and press the ENTER button.
 - iii. Highlight **Save** and press the ENTER button when the **Estimated Accuracy** field and/or **Measurement Count** field reaches the desired value. **DO NOT** move the unit while averaging the position.
 - iv. Highlight '**Done**' and press the ENTER button to save your position.
 - v. It takes about 1 minute to collect 60 measurement counts.

- d. Accuracy of waypoint collection
 - i. With SA turned off you can expect the Garmin III+ GPS unit to calculate it's location within **4-7 meters (12-20 ft.)** of it's true position, but if the unit doesn't have good satellite coverage that range could increase to **10-20 meters (33-66 ft.)**
 - ii. With SA turned on you can expect errors of **100 meters (330 ft.)** when taking an instant reading waypoint. Using the average position format for waypoint collection may help to reduce the error.
 - iii. Methods to reduce error
 - (1) Avoid electrical interference; i.e. avoid taking measurements near electrical substations or high voltage power lines.
 - (2) Make sure antenna has a clear view of sky. (Try to stay away from areas with dense vegetation overhead.)
 - (3) Check the Estimated Position Error (EPE) and Dilution of Precision (DOP) on the Satellite Status Page. The lowest numbers are the best accuracy and the highest the worst for each. The DOP measures satellite geometry quality on a scale of one to ten. The EPE uses the DOP to calculate a horizontal position error in feet/meters. **A DOP <4.0 shall be required for all waypoints submitted for database/mapping purposes.**
 - (4) Check the Satellite Status Page and **make sure the unit has a good lock on at least four satellites.** The unit works best when it is receiving strong signals from many satellites located at different angles from the unit. The left side of the screen shows the position of the satellites in the sky. The satellites are displayed by an assigned number. Highlighted satellites are being used by the unit to determine it's location. The right side of the screen shows the strength of each satellite signal the unit is receiving. The higher the bar the better the signal. A grey bar indicates that the satellite has been found by the unit and the receiver is collecting data from it. A black bar indicates that the unit is using that satellite to calculate it's position.
 - (5) If available, a powered antenna can help to reduce error by improving the reception of satellite signals.

7. Data Processing

- a. Uploading waypoint data from Garmin unit to a PC using *MapSource*® software
 - i. Connect the Garmin to the PC using the supplied interface cable.
 - ii. In the menu bar go to **File / Open From GPS...**
 - iii. Select waypoints and click on **OK**.
 - iv. By clicking on the waypoint tab on the left of the screen you can see a list of all the waypoints you have collected.
 - v. Save the *MapSource*® file (*.mps) for future reference.
 - (1) In the menu bar go to **File / Save as...**
 - (2) Type the desired name for the file in the File Name field. The file name chosen should conform to your Bureau's/Program's SOPs.
 - (3) Hit enter to save the file.
- b. Export waypoint data from *MapSource*® program to an ASCII comma delimited text file.
 - i. Select the waypoint tab in the left hand window.
 - ii. Select all of the waypoints from the left of the screen that you want exported using a shift or control click (**Ctrl + A** selects all).
 - iii. Copy (**Ctrl + C**) the waypoints to the clipboard.
 - iv. Open a spreadsheet program such as Corel Quattro Pro.
 - v. Paste (**Ctrl + V**) the waypoints to a worksheet.
 - vi. This will create a spreadsheet giving you a table of information regarding your waypoints. Included is the waypoint name, time and date of waypoint collection, and the lat/long coordinates of the waypoint.
 - vii. Select the column with the lat/long coordinates.
 - viii. Select **Tools / Data Tools / Quick Columns.**
 - ix. Select the **Block** option for the source.
 - x. Select the Destination columns by clicking on the arrow button next to the entry block. This will temporarily close the Quick columns Expert window to allow you to select these columns. Select the currently selected column and the one next to it using a shift click. Then click on the "maximize" button on the Quick columns Expert window.
 - xi. Click the **options** button.
 - xii. Select **Delimited** from the **Data Type** pull down.

- xiii. Select **“Space”** for the delimiting type (selection buttons).
 - xiv. Click **OK**.
 - xv. Click **Parse**.
 - xvi. Click **Yes** to overwrite the existing data.
 - xvii. The coordinates should now be in two columns one for the latitude and one for the longitude
 - xviii. Delete the columns you do not need (Symbol & Name, Unknown). Make any editorial changes you need to make to Descriptions, ID numbers, etc. Be VERY careful NOT to alter the coordinates. You will NOT need to add column headings. They will be added by the GIS analyst.
 - xix. Saving this file as an ASCII text file in comma delimited form.
 - (1) In the menu bar go to **File / Save as...**
 - (2) Type the file name in the File Name field. The file name should include g3 (to indicate that a Garmin GPS III+ was used to collect the data), the first, middle and last initials of the person who collected the data, and the three digit day of year with underscores between the three. (For example: g3_jjc_108 would indicate that a Garmin GPS III+ was used by James Joseph Cronin on April 17 to collect the points. If two people have the same initials use the first two initials and a last name to differentiate between the two.)
 - (3) Click on the File Type field and scroll down to select **ASCII Text (“Comma delimited”)**.
 - (4) Hit enter to save the file.
 - (5) The file should be put on a shared drive under a directory used to store ASCII text files including waypoint data and under a sub-directory indicating what year the information in the file came from.
 - xx. Printing out this file will give you all the information you need to enter the locations into the GIS “FEATURE DATA” database of KDHE points, except for the county that the point is located in.
 - c. Using the information in the ASCII text file the feature locations can be entered into a larger database of KDHE sites using a Lotus Notes application called “FEATURE DATA”. If interested, contact the GIS Unit at (785) 296-8078 for status and participation.
8. Troubleshooting
- a. If the batteries run low a warning box titled **Battery Power Low** will pop up on the screen. If you see this you should replace the batteries.
 - b. If the unit is not under sufficient satellite coverage a warning box titled **Poor GPS Coverage** will pop up on the screen. If you see this you need to move to another location to give the antenna a clearer view of the sky.
 - c. If a message pops up on the screen that you don’t understand, refer to *Appendix E* in the Owner’s Manual & Reference to get a description of the message.
 - d. If any unresolvable or unrecognizable problem occurs with the unit while being used for field data collection, the unit is to be turned off and returned to the Bureau’s/Program’s GPS Administrator for inspection.
9. Data Output
- a. Once features are entered into the database, you can use software such as Crystal, ArcView, and VB Viewer to create a table of features that suit your needs.
 - b. This table can then be used in ArcView to create a map of your feature locations.
 - c. With assistance from the GIS unit, you can get the features included on the KDHE Intranet IMS site, which will place your features on a map.
 - d. Any questions regarding map or table creation of desired feature locations should be directed to the GIS unit at (785) 296-8078.
 - e. The *MapSource*® software can also be used to perform a variety of tasks.

Appendix A: Glossary of terms

- ASCII comma delimited text file - a file that separates columns of information with commas.
- AshTech Reliance - a GPS unit that is more accurate than the Garmin GPS III+.
- Average Position Waypoint Collection - allows you to average position samples over time and save the averaged result as a waypoint. Averaging reduces the effects of selective availability on position error and results in a more accurate position reading.
- AutoLocate - the unit searches for available satellites to determine its position. This option is useful if you've relocated a long distance (>500 miles) from the last location the GPS III+ was used.
- Dilution of Precision (DOP) - A measure of the GPS receiver-satellite geometry. A low DOP value indicates higher accuracy. The DOP indicators are GDOP (geometric DOP), PDOP (position DOP), HDOP (horizontal DOP), VDOP (vertical DOP), and TDOP (Time clock offset).
- Estimated Position Error (EPE) - A measurement of horizontal position error in feet or meters based upon a variety of factors including DOP and satellite signal quality.
- Feature Data database - a KDHE GIS database designed to store GPS information for various feature locations. It is currently in the testing phase.
- Geographical Information System (GIS) - A computer system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data related to positions on the Earth's surface.
- Global Positioning System (GPS) - A global navigation system based on 24 satellites orbiting the earth at an altitude of 10,900 miles and providing very precise, worldwide positioning and navigation information 24 hours a day, in any weather. Also called the NAVSTAR system.
- Horizontal Positional Accuracy - the accuracy of a location on a 2D surface.
- Instant Reading Waypoint Collection - the unit takes it's current position reading and saves it as a waypoint.
- Selective Availability (SA) - This is an artificial error introduced into the satellite data by the US DoD to reduce the possible accuracy of a position to 100 meters for commercial users. SA was turned off on 5/01/2000 through a federal executive order to encourage the use of GPS units for non-military purposes. It can be turned on again for national security reasons at any time.
- Waypoint - the technical term for a location whose coordinates you store.

Appendix B: Checklist of applicable field equipment and supplies

- Garmin GPS III+ unit
- Owner's Manual & Reference Guide
- Carrying case
- Cigarette lighter power adapter
- PC Interface Cable
- Garmin *MapSource*® software CD
- Notebook for logging data
- Powered antenna (optional)

APPENDIX A

STANDARD OPERATING PROCEDURE BER-33

PROCEDURES FOR SAMPLING AND ANALYSIS OF INDOOR AIR SAMPLES

BUREAU OF ENVIRONMENTAL REMEDIATION

STANDARD OPERATING PROCEDURE BER-33

**PROCEDURES FOR SAMPLING AND
ANALYSIS OF INDOOR AIR SAMPLES**

Revisor: Bill Morris Date of Revision: 12/19/05

Remedial Section Chief: _____ Date: _____

Tank Section Chief: _____ Date: _____

ARS Section Chief: _____ Date: _____

Bureau QA Representative: _____ Date: _____

Bureau Manager: _____ Date: _____

Revisor: Bill Morris Date of Revision: 1/27/07

Remedial Section Chief: _____ Date: _____

Tank Section Chief: _____ Date: _____

ARS Section Chief: _____ Date: _____

Bureau QA Representative: _____ Date: _____

Bureau Manager: _____ Date: _____

Revisor: _____ Date of Revision: _____

Remedial Section Chief: _____ Date: _____

Tank Section Chief: _____ Date: _____

ARS Section Chief: _____ Date: _____

Bureau QA Representative: _____ Date: _____

Bureau Manager: _____ Date: _____

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ATTACHMENT ONE - FIELD DATA AIR SAMPLING FORM

ATTACHMENT TWO - SAMPLING INSTRUCTIONS FOR CANISTERS
WITH PNEUMATIC FLOW CONTROLLERS

1. INTRODUCTION

This procedure describes field protocols for sampling and analytical methods to determine the presence of VOCs in ambient, indoor, or workplace atmospheres. This method establishes standard operating procedures for the collection of air samples in passivated (inert) stainless-steel canisters.

2. SAMPLING EQUIPMENT

Indoor air samples will be collected in specially prepared six liter stainless-steel spheres. The laboratory will provide either SUMMA canisters or SilcoCans for the sampling. Air flow into the canister is regulated by a sampling valve (fixed orifice) or a pneumatic flow controller, attached to an in-line particulate filter. The sampling valve is typically used for short duration grab samples; however, the valve can be set for longer duration sampling. A flow controller can be preset to regulate flow for sample collection times of 1-hour, 3-hours, 8-hours, 12-hours or 24 hours. Larger canisters are available for sampling periods in excess of 24-hours. The desired sampling rate is pre-set either by the canister manufacturer or the laboratory. Canisters will be cleaned and certified by the laboratory as per EPA Method TO-14A or TO-15 guidelines.

A vacuum gauge is utilized to measure and record the initial canister vacuum. A post sampling vacuum reading is taken when sampling is performed with a flow controller. This item may not typically be supplied by the laboratory but is available upon request. The canister vacuum should be approximately minus 26 - 30" of Hg. If the initial vacuum is less than 26" of Hg, the canister should be rejected and returned to the laboratory.

Stainless-steel, Teflon or Nylon tubing can be attached to the inline filter to obtain samples from the breathing zone or a remote location. The inlet manifold is placed in the breathing zone at approximately three to five feet above grade. The laboratory will supply this material upon request.

3. BACKGROUND REVIEW

An adequate background review must be conducted to obtain information on each structure from which a sample is collected. Conduct a survey of each structure to ascertain basement, crawl space or slab on-grade building configuration. Determine if sumps, wells, or cisterns are associated with each structure. Evaluate the condition of the floors and walls, furnace use (fuel type) and building ventilation. These features may act as conduits that will facilitate the migration of VOCs from the soil and/or groundwater plume. An attached garage, basement or workshop may store products that can contribute to contaminant impacts.

Interviews should be conducted to assess the use of potential contaminants, frequency of use, storage, as well as methods of handling and disposal. Additional information that is vital to

adequately evaluate potential health risks include the following: the length of occupant residency; the ages of the adults and children that live in the structure; if the occupants smoke and how often. Any hobbies that use paints or solvents should be noted. The data referenced in this section should be entered on the Field Data Air Sampling Form in Attachment One.

4. PRELIMINARY SCREENING

Primary sampling areas will be in basements and/or the lowest potential living level, near sumps or other potential source areas. Preliminary screening of the sampling area may be conducted through use of photoionization detectors (PID) or colorimetric tubes. Screening, and subsequent sampling, will be conducted in the center of the room away from obstructions in the breathing zone, near potential sources, basements and crawl spaces. PIDs will be checked and calibrated according to manufacturers directions. Additional preliminary factors to be documented will include indoor and outdoor temperature, wind speed/ direction, and barometric pressure.

Preliminary screening and subsequent sampling can also be conducted in buildings or residences outside the area of concern to evaluate background levels of various constituents that may impact data interpretation. It is also important to collect ambient air data to evaluate outdoor concentrations that may affect indoor air quality. The data referenced in this section should be entered on the Field Data Air Sampling Form in Attachment One.

5. SAMPLING PROCEDURES

Laboratory prepared sampling apparatus configurations may vary. Specific instructions and/or diagrams for system assembly, if any, should be obtained from the laboratory supplying the canister(s). Canisters should not be placed in the kitchen, in areas of high humidity (bathroom/laundry room), near windows, or heat registers. Record the local outdoor temperature, relative humidity and barometric pressure on the Field Data Air Sampling Form in Attachment One.

Sampling equipment apparatus may be assembled as follows: connect the flow controller, with attached in-line filter and vacuum gauge, to the canister utilizing a compression fitting; connect a sampling tube (if used) to the sample inlet on the filter; place the canister in the predetermined location and begin sampling by turning the canister valve counter-clockwise one full turn or as specified; after sampling is complete, close the canister valve and record the canister vacuum. Do not over-tighten the valves or compression fittings.

The final canister vacuum should be less than atmospheric to ensure that a constant flow rate was used for the entire sampling period. Attach an identification tag that indicates the canister serial number, sample number, location, and date to the canister for transport to the laboratory. The canisters will be shipped under proper chain-of-custody protocol. Canisters must be returned to

the laboratory from which they were rented for analysis. A copy of sampling instructions for canisters with pneumatic flow controllers is in Attachment Two.

6. SAMPLE ANALYSIS

The canisters provide storage stability for many VOCs for a period of up to 30 days. Collected samples will be submitted for laboratory analysis by either EPA Method TO-14A (EPA, January, 1997) or EPA Method TO-15 (EPA, January, 1997). EPA Method TO-14A is the more recognized method for analysis of unknown trace VOCs and is more sensitive. This method can analyze up to 41 of 187 hazardous air pollutants listed in the Title III Clean Air Act Amendment (CAAA). EPA Method TO-14A uses single or multiple detectors which are generally less desirable than the mass spectrometry detector utilized by EPA Method TO-15.

The mass spectrometry utilized for EPA Method TO-15 is a more scientifically defensible detector scheme that has a more definitive identification technique for VOC analysis than TO-14A. Therefore, EPA Method TO-15 can be applied with a higher confidence which reduces uncertainty in risk assessments that evaluate VOCs. A larger number of Title III CAAA compounds can be analyzed (97 of 187) by EPA Method TO-15. Detection limits for the various analytes, with either EPA method, range from 0.2 ppbv - 25 ppbv. A selective ion monitoring (SIM) mode is possible with the TO-15 method for chlorinated VOCs that can achieve lower detection limits. The laboratory should be contacted related to which type of sample you are collecting and the type of analysis or detection limit you wish to achieve.

A number of laboratories conduct air sampling analysis. The referenced lab methods can be located on the world wide web at the following addresses:
<http://www.epa.gov/ttn/amtic/files/ambient/airtox/to-14ar.pdf>
or <http://www.epa.gov/ttn/amtic/files/ambient/airtox/to-15r.pdf>

References:

Method TO-14A - Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography, EPA, January, 1997

Method TO-15 - Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry, EPA, January, 1997

ATTACHMENT ONE

FIELD DATA AIR SAMPLING FORM

FIELD DATA AIR SAMPLING FORM

Site Name: _____

Sample Identification: _____ / _____

Date Sampled: _____

Sample

Location(s): _____

Sampler: _____

Canister Serial

#: _____ / _____

Environmental ConditionsOutdoor Temperature: _____ Barometric Pressure: _____ Wind
Speed/Direction: _____

Relative Humidity: _____ Comments: _____

Preliminary Screening

Instrumentation: _____ Calibration Date: _____ Time: _____ am/pm

Field Reading(s): _____ (ppm)/ _____ (ppm)/ _____ (ppm)/ _____ (ppm)

Location(s): _____

Air Sampling

Time	Pressure	Controller Flow
Start: _____ am/pm	_____ psig	_____

Stop: _____ am/pm	_____ psig	_____
-------------------	------------	-------

Start: _____ am/pm	_____ psig	_____
--------------------	------------	-------

Stop: _____ am/pm	_____ psig	_____
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FIELD DATA AIR SAMPLING FORM

Residential Questionnaire

Tenant's Name(s): _____ Age: _____ Tenure: _____

Address: _____

Smoker(s): Y/N Product (Cigars, Pipe, Cigarettes): _____ Number
Smoked/Day: _____

Basement/Crawl Space: Y/N Ventilated: Y/N Living Quarters: Y/N

Basement

Activities: _____

Private Well: Y/N Sump: Y/N Cistern: Y/N In Use/Plugged: Y/N

Recent Remodeling: Y/N Activities (painting, new carpet, new cabinets): Y/N

VOC sources (hobbies, paints, solvents, gasoline,
etc.): _____

Cleaning Products and
Storage: _____

Attached Garage: Y/N Garage Storage (cars, lawn mover,
etc.): _____

Furnace Type (Oil, Natural Gas, Propane): _____ Furnace Intake: Inside/Outside

Additional Heating Sources (space heater, etc.): _____ Fuel Type: _____

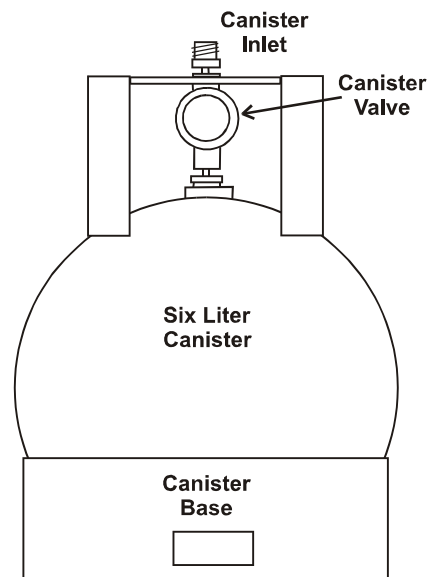
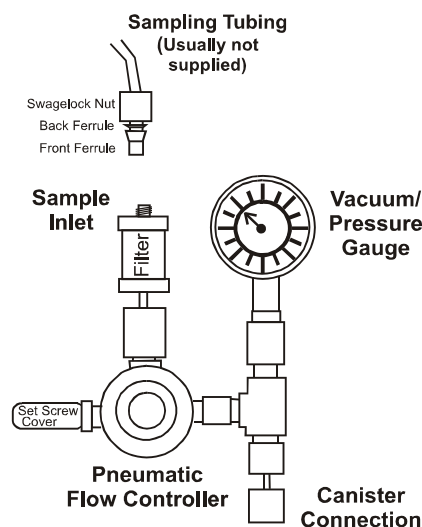
Comments: _____

ATTACHMENT TWO

SAMPLING INSTRUCTIONS FOR CANISTERS WITH PNEUMATIC FLOW CONTROLLERS

Sampling Instructions for Canisters With Pneumatic Flow Controllers

1. Inspect your canister shipment upon arrival. Compare the contents with the packing slip and notify the lab of any discrepancy or damage.
2. Familiarize yourself with this diagram and the equipment that you received. The flow controller will be set for the appropriate sampling rate in the laboratory and should not require adjustment.
3. Remove the brass caps from the flow controller and canister. Connect the flow controller to the canister by inserting the "canister connection" into the "canister inlet" and hand tighten the swagelock nut being careful not to cross the threads. Using two open end wrenches (1/2" & 9/16") tighten the nut no more than 1/8 turn past finger tight. DO NOT use adjustable wrenches or pliers.
4. The fittings are swagelock compression fittings. Do not use teflon tape or other sealants, they are not necessary. DO NOT over-tighten any connection. Over-tightening causes leaks, not fixes them.
5. The canister and controller are now ready for ambient air sampling. If you intend to sample a remote location or source, you will need to attach a sampling line. This should be 1/4" O.D. tubing of virgin Teflon or cleaned stainless steel.
6. If arranged with your canister order, the lab will provide a swagelock nut and set of nylon ferrules for connecting line. Slide the nut, the back ferrule, then the front ferrule onto the tubing. Insert the tubing into the sample inlet and slide the ferrules into the fitting. Secure the nut being careful not to cross the threads. When using nylon ferrules, a snug finger tight should be sufficient for a leak free connection.
7. To begin sampling, simply open the canister valve by turning clockwise. One full turn is sufficient. Note the vacuum gauge reading. The vacuum gauge reading should be near the barometric pressure.
8. You can watch the decline in the vacuum to gauge the sampling rate. A one hour sample should drop in vacuum at a rate of 0.5" Hg per minute (i.e. 30"/60 min). Remember this is a rough estimate. The sampling rate is normally set in the laboratory. Occasionally the controller will lose calibration in shipment. If necessary contact the lab for assistance.
9. After sampling is complete, close the canister valve by turning clockwise until finger tight. DO NOT over-tighten as this WILL damage a very expensive valve.
10. Disassemble the components in reverse order of the above assembly instructions. Return all components to the original shipping containers and package them as received.
11. Verify that all parts are packed for return by referencing the packing slip. The project will be charged for all missing or damaged components.
12. Complete a Chain-of-Custody Record and return the sample to the laboratory for analyses.



Teflon will sometimes have very low level freon contamination.

APPENDIX A

STANDARD OPERATING PROCEDURE BER-34

PROCEDURES FOR SAMPLING AND ANALYSIS OF SUB-SLAB AIR SAMPLES

BUREAU OF ENVIRONMENTAL REMEDIATION

STANDARD OPERATING PROCEDURE BER-34

**PROCEDURES FOR SAMPLING AND
ANALYSIS OF SUB-SLAB AIR SAMPLES**




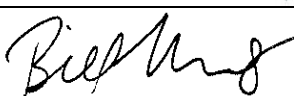

Revisor:	Bill Morris	Date of Revision	December 18, 2006
Remedial Section Chief		Date	3-3-07
Tank Section Chief		Date	3/29/07
ARS Section Chief		Date	3-30-07
Bureau QA Representative		Date	4-1-07
Bureau Manager		Date	4/5/07

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1. INTRODUCTION

This procedure describes field protocols for the installation of sub-slab sampling ports and sampling and analytical methods to determine the presence of VOCs in vapor directly below the foundation of a building. This method establishes standard operating procedures for the installation of the sub-slab sampling ports and the sampling protocols for obtaining sub-slab soil vapor samples.

2. SAMPLING EQUIPMENT

Sub-slab air samples can be collected in two ways depending on the analytical methodology chosen. Samples can be collected for field analysis or for laboratory analysis. Samples collected for field analysis should be collected with polyethylene syringes equipped with a three way valve (Figure 1). These syringes are used to purge three line volumes prior to the collection of any samples. Laboratory samples should be collected in one liter, or smaller, stainless-steel canisters. Sub-slab samples may be collected as grab samples or as time-integrated samples. Time integrated samples would only be collected for laboratory analysis and should be collected into a canister that is equipped with a sampling valve or a pneumatic flow controller, attached to an in-line particulate filter. A flow controller can be preset to regulate flow for sample collection times of minutes, 1 hour, 8 hours, 24 hours, etc. If a flow controller is not used, then the valve should be opened slowly and the sample should be collected over several minutes to decrease the chance of short-circuiting. Sub-slab samples should never be collected at a rate greater than 200 ml/min. If field analytical is the primary analytical tool being used the syringes can be used to purge the line and then collect the sample for immediate analysis. Canisters will be cleaned and certified by the laboratory as per EPA Method TO-14A or TO-15 guidelines.



Figure 1

A pressure/vacuum gauge is utilized to measure and record the initial canister vacuum pressure. A post sampling vacuum reading is taken to ensure that a full one liter of sub-slab vapor is collected. An inline sampling apparatus with pressure gauge can be used to measure vacuum readings. The initial canister pressure should be approximately 26 – 30 in. of Hg. If the initial pressure is less than 26 in. of Hg, the canister should be rejected and returned to the laboratory.

Stainless-steel, Teflon, or nylon tubing can be used to obtain sub-slab samples. Swagelok® fittings should also be used for airtight connections. The laboratory should supply these materials upon request. Sampling tubing should only be used once.

3. SAMPLING PORT INSTALLATION

Sampling port(s) should be located in areas that can give results that are representative of sub-slab conditions across the entire slab. Attempts should be made to install the ports in inconspicuous locations. KDHE usually installs the port under carpeting in a corner away from

footings, under floor tiles or in unfinished areas, out of direct visibility. Utilities should be located and sampling ports should not be installed directly above any utilities. When drilling through the slab, care should be exercised as to not penetrate the materials below the slab. If the basement has bearing walls that require footings under the slab, then multiple sampling ports may be needed to account for spatial variability.

The sampling ports are to be constructed of stainless steel or brass. They can be constructed with $\frac{1}{4}$ in. or less materials. KDHE commonly uses $\frac{1}{4}$ in. brass nipple, $\frac{1}{4}$ in. brass coupler and a $\frac{1}{4}$ in. flush seating pipe plug (Figure 2). A rotary hammer is used to drill into the concrete. The



Figure 2

installation requires two masonry bits, $1\frac{1}{4}$ in. to $1\frac{1}{2}$ in. for the outer hole and $\frac{5}{8}$ in. to $\frac{1}{2}$ in. bit for the inner hole (Figure 3). The larger bit is used to make a hole that is approximately one inch deep and the smaller bit is used to complete the hole through the slab.



Figure 3

Once the hole is completed and cleaned, then the sampling port can be installed flush with the surface of the concrete. A neat cement mixture is used to seal the sampling port in place (Figure 4). The neat cement is Portland cement with about 1-3% bentonite powder added. The concrete mixture should be allowed to cure for at least 24 hours prior to being disturbed. Teflon tape is used to seal the threaded pipe plug in place. **Sub-slab sampling ports should never be installed in slabs that may come into contact with a high water table.**



Figure 4

4. SAMPLING PROCEDURES

Sampling of sub-slab vapor is done by removing or pulling air from the space directly below the slab. This can be done with a syringe (field analytical) or an evacuated canister (laboratory analysis). For either method a sampling tube is attached to the sub-slab port and must be purged. KDHE requires that three line volumes be removed prior to sampling. Tubing with $\frac{1}{4}$ in. outside diameter (O.D.) will usually have an inside diameter (I.D.) of $\frac{1}{8}$ in. or $\frac{5}{32}$ in., and volume of approximately 2.2 milliliters per foot (mL/ft.) and 3.8 mL/ft., respectively. The syringe shown in Figure 1 can be fitted to $\frac{1}{4}$ in. O.D. tubing and three line volumes evacuated. If field analytical is performed then the syringe, with a three-way valve, can be used to collect an additional 20-30 mL of air. If laboratory samples are preferred then attach a Swagelok® nut, washer and ferrule and attach to a one liter evacuated canister (as shown in Figure 5).

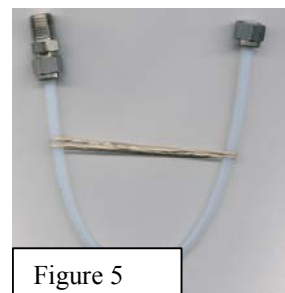


Figure 5

Samples should be collected carefully as to avoid short-circuiting. Sampling over several minutes should allow enough time for the canister to completely lose all of its vacuum. After sampling is complete, close the canister valve and record the canister vacuum pressure. Do not over-tighten the valves or compression fittings.

Attach an identification tag that indicates the canister serial number, sample number, location, and date to the canister for transport to the laboratory. The canisters will be shipped under proper chain-of-custody protocol. Canisters must be returned to the laboratory from which they were rented for analysis. Once sampling is completed Teflon tape should be applied to the plug, and the sampling port should be sealed.

5. SAMPLE ANALYSIS

Field analysis will be performed according to SOP BER-25 Mobile Laboratory. Detection limits for most compounds will be low enough to make decisions regarding vapor intrusion exposure estimates.

The canisters provide storage stability for many VOCs for a period of up to 30 days. Collected samples will be submitted for laboratory analysis by either EPA Method TO-14A (EPA, January, 1997) or EPA Method TO-15 (EPA, January, 1997). EPA Method TO-14A is the more recognized method for analysis of unknown trace VOCs and is more sensitive. This method can analyze up to 41 of 187 hazardous air pollutants listed in the Title III Clean Air Act Amendment (CAAA). EPA Method TO-14A uses single or multiple detectors which are generally less desirable than the mass spectrometry detector utilized by EPA Method TO-15.

The mass spectrometry utilized for EPA Method TO-15 is a more scientifically defensible detector scheme that has a more definitive identification technique for VOC analysis than TO-14A. Therefore, EPA Method TO-15 can be applied with a higher confidence which reduces uncertainty in risk assessments that evaluate VOCs. A larger number of Title III CAAA compounds can be analyzed (97 of 187) by EPA Method TO-15. Detection limits for the various analytes, with either EPA method, range from 0.2 ppbv - 25 ppbv. A number of laboratories conduct air sampling analysis.

References:

Method TO-14A - Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography, EPA, January, 1997

Method TO-15 - Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry, EPA, January, 1997

APPENDIX A

STANDARD OPERATING PROCEDURE BER-35

INSTALLATION OF VAPOR MONITORING WELLS

BUREAU OF ENVIRONMENTAL REMEDIATION

STANDARD OPERATING PROCEDURE BER-35

INSTALLATION OF VAPOR MONITORING WELLS





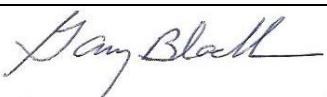
Revisor:	Bill Morris	Date of Revision	December 18, 2006
Remedial Section Chief		Date	3-3-07
Tank Section Chief		Date	3/29/07
ARS Section Chief		Date	3-30-07
Bureau QA Represetative		Date	4-1-07
Bureau Manager		Date	4/5/07

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1. INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to establish a basic procedure for installation of vapor monitoring wells. Vapor wells can be installed using hand auger equipment or direct push equipment (i.e. KDHE's Geoprobe 5400 and 4200 units). Use of this SOP is limited to KDHE and KDHE contractors.

2. METHOD SUMMARY

Small diameter inert tubing is used in conjunction with a small screen or inert perforated tip installed down a variety of borehole diameters. Boreholes can be created with hand equipment or direct push systems. Small discreet areas of the formation can be sampled for soil gas using vapor wells. Several tubes can be installed in the same borehole at varying depths (nested). Nested vapor wells will be grouted (sealed) to ensure that the sample collected is from the targeted depth in the vadose zone.

3. PROCEDURE

To install the well the borehole must first be created. In coarse materials it may be necessary to use direct push equipment with rods generally used to install mini-wells, (e.g. outer 2.125 in. diameter rods). In this instance the vapor well will be installed in the inside of the rod. Sand pack and granular bentonite will be delivered down the inside of the rod during removal of the rods. Be careful not to pull the tubes when extracting the rods. For tighter soils it is usually easier to advance the rod or hand auger (e.g. small diameter rods with 2 in. pre-probe, or 2 in. hand auger) to the desired depth, then remove the rod or auger completely. The vapor wells can then be installed, provided the bore-hole will stay open.

Ensure the desired depth is achieved prior to installing any materials into the bore hole. A typical vapor well point will be centered in approximately 6-12 in. of granular material (e.g. sand, glass beads, etc.) in the borehole. A granular bentonite plug, placed directly above the sand pack and hydrated, usually consists of approximately two inches of small granular bentonite and 120-150 ml of de-ionized (D.I.) water. Granular bentonite should be added to the borehole until you reach the surface or to the bottom of the next interval you wish to sample. For nested wells, hydrating the bentonite to seal the bottom of the next interval should be completed prior to adding the next sand pack and probe. An example of a nested vapor well is shown in Figure 1.

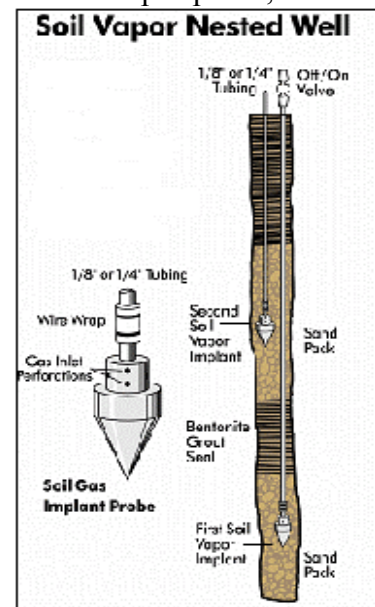


Figure 1
(Courtesy of H&P Mobile Geochemistry)

Other items to remember when installing nested vapor wells are as follows:

- Cut probe tubing to an appropriate length to reach the surface, allowing enough material for whatever surface completion is required
- Ensure the probe tip is located in the middle of the sand pack
- For deeper applications, it may be necessary to add weight to the tip to allow for easier installation
- Hydrating grout above and below each gravel pack ensures adequate seals for vapor sampling
- Label tubes as they are installed and make sure the identification system remains in place for future resampling
- Terminate surface ends of tubes with Swagelok caps, valves, or other desired terminations
- If a single depth vapor well is installed after the seal is hydrated, grout to the surface unless a permanent surface completion is to be installed

4. SAMPLING CONSIDERATIONS

For vapor intrusion sampling, minimum purge volumes and low volume samples are preferred to minimize potential breakthrough from the surface or between sampling intervals. Inert tubing should be used for well construction usually 1/8 in. or 1/4 in. outside diameter (O.D.) and three line volumes should be removed prior to sampling. For 1/8 in. and 1/4 in. tubing that is approximately 4.5 ml and 18 ml per foot, respectively. If sampling the vapor well within 12 hours of installation, then three dead volumes of the sand pack should also be purged (! 100 ml for 2 in. inside diameter (I.D.) borehole per foot of sand pack, 30% sand porosity).

Samples can be collected similarly to soil gas samples as described in section 2.3 of BER-07 (Geoprobe Operations) or section 5 of BER-34 (Procedures for Installation, Sampling, and Analysis of Sub-slab Air Samples). This includes the use of syringes and stainless steel canisters. At all times purge and sample volumes should be kept to a minimum. Samples from vapor wells can also be analyzed in the field using KDHE's mobile laboratory. Protocols for vapor sampling analysis are detailed in BER-25, Mobile Laboratory.

5. SPECIAL CONSIDERATIONS

- Vapor well installations should be performed by individuals familiar with vapor intrusion investigations or they have experience with vapor well installation

- It may be necessary to use tracer compounds to ensure that breakthrough from the surface is not occurring. Typically iso-propanol, butane, difluoroethane, helium, etc. are used for this purpose
- If other parameters are to be analyzed in the field (i.e. oxygen, carbon dioxide, etc.) they should be analyzed for after samples are collected for laboratory analysis and field analysis

Only a KDHE operator properly trained by the manufacturer (Geoprobe in the case of KDHE's unit) is allowed to install such wells. All flush-mounted well installation will require the standard waiver currently issued for larger-diameter drilled monitoring wells.